



RESEARCH DIGEST

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The aim of the *Research Digest* is to advance and communicate knowledge on hazard mitigation and disaster preparedness, response, and recovery within an all-hazard, interdisciplinary framework.

Research Digest is a quarterly online publication (www.colorado.edu/hazards/rd) that compiles recent research into an easily accessible format for the hazards and disasters community. It provides complete references and abstracts (when available) for current research in the field. The issues are compiled and edited by library and research staff and include more than 35 peer reviewed publications.

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All Hazards

Gardner, James S., and Julie Dekens. 2007. Mountain hazards and the resilience of social-ecological systems: Lessons learned in India and Canada. *Natural Hazards* 41(2): 317-36.

Mountain regions are subject to a variety of hazardous processes. Earthquakes, landslides, snow avalanches, floods, debris flows, epidemics, and fires, among other processes, have caused injury, death, damage, and destruction. Mountainous regions also face challenges from increased populations, and expansion and intensification of activities, land uses, and infrastructure. The combination of a dynamic bio-geophysical environment and intensified human use has increased the vulnerability of mountain social-ecological systems to risk from hazards. The ability of social-ecological systems to build resilience in the context of hazards is an important factor in their long-term sustainability. The role of resilience building in understanding the impact of hazards in mountain areas is examined and illustrated, in part, through examples from Canada and India. Resilient social-ecological systems have the ability to learn and adjust, use all forms of knowledge, to self-organize and to develop positive institutional linkages with other social-ecological systems in the face of hazards. The analysis suggests that traditional social-ecological systems built resilience through avoidance, which was effective for localized hazards. The more recent development and implementation of cross-scale institutional linkages is shown to be a particularly effective means of resilience building in mountain social-ecological systems in the face of all hazards.

Gow, Gordon A. 2007. Disaster mitigation and communications research in Canada: Towards a responsive innovation agenda. *International Journal of Emergency Management* 4(2): 122-40.

The aim of this paper is to introduce a new conceptual framework for communications policy research pertaining to disaster mitigation in Canada. It claims that mitigation-oriented policy research must expand its agenda to focus on the deep social roots of risk and vulnerability in Canadian society and that such a re-orientation in theory can provide the foundation for the reform of public policy and practical action suited to the National Disaster Mitigation Strategy. Key findings from a recent study of Canada's communications infrastructure are cited to introduce three research themes—learning, innovation, and enabling—that

can serve as the foundation for a 'responsive innovation agenda.' The paper introduces this agenda, specifies its core normative principle, and then provides a number of real-world cases that can inform ongoing research efforts towards its realization.

Morlok, Edward K. 2007. Disaster and degradation management: Relevance of the concept of flexibility. *International Journal of Critical Infrastructures* 3(3/4): 327-45.

This paper attempts to present the case that the concept of flexibility is very relevant to the subject of disaster and degradation management in transportation systems. Fundamentally, flexibility concepts provide measures of the ability of a system to maintain satisfactory performance when uncontrollable and often unforeseen events (disasters) occur. Thus they provide a basis for planning, design and operation—management in a broad sense—of systems so that the impact of disasters is minimized. This is argued from a conceptual standpoint, addressing the kinds of issues that disasters create, and the scope of flexibility analysis. Finally, examples of such analyses are given, using the taxonomy of types of system degradation that results from a flexibility perspective.

Paton, Douglas. 2007. Preparing for natural hazards: The role of community trust. *Disaster Prevention and Management* 16(3): 370-9.

This paper seeks to examine how perception of the relationship between people and sources of information influences hazard preparedness and how trust in civic emergency planning agencies responsible for risk communication influences preparedness decisions. It aims to hypothesize that familiarity with and information about hazards predicts the relative importance of trust, and that levels of trust are influenced by community characteristics. A cross-sectional analysis of the relationship between trust and hazard preparedness was conducted. Hypotheses were tested using data on bushfire, volcanic, and earthquake hazards. Data were analyzed using multiple regression analyses. The first hypothesis, that situational factors predict the relative importance of trust, was supported. Partial support was forthcoming for the second hypothesis. Collective problem solving and empowerment predicted levels of trust. The findings demonstrated the utility of this multi-level model for the analysis of risk communication and need to accommodate societal-level variables in future risk communication research. The source of information plays a role in risk communication that is independent of the information per se. The relationship between people and civic agencies and the information provided must be accommodated in planning risk communication. The analysis provides an evidence-based framework for the development of risk communication strategies based on community engagement principles. This is the first time this multi-level model has been applied to natural hazards and contributes to understanding the contingent nature of the risk communication process.

Climate Change, Drought, and El Niño

Arguez, A., A. M. Waple, and A. M. Sanchez-Lugo. 2007. State of climate in 2006. *Bulletin of the American Meteorological Society* 88(6): 929-32.

Brouwer, Roy, Sonia Akter, Luke Brander, and Enamul Haque. 2007. Socioeconomic vulnerability and adaptation to environmental risk: A case study of climate change and flooding in Bangladesh. *Risk Analysis* 22(2): 313-26.

This article investigates the complex relationship between environmental risk, poverty, and vulnerability in a case study carried out in one of the poorest and most flood-prone countries in the world, focusing on household and community vulnerability and adaptive coping mechanisms. Based upon the steadily growing amount of literature in this field, the authors develop and test their own analytical model. In a large-scale household survey carried out in southeast Bangladesh, they ask almost 700 floodplain residents living without any flood protection along the River Meghna about their flood risk exposure, flood problems, flood damage, and coping mechanisms. Novel in the study is the explicit testing of the effectiveness of adaptive coping strategies to reduce flood damage costs. The authors show that households with lower income and less access to productive natural assets face higher exposure to risk of flooding. Disparity in income and asset distribution at the community level furthermore tends to be higher at higher risk exposure levels, implying that individually vulnerable households are also collectively more vulnerable. Regarding the identification of coping mechanisms to deal with flood events, the authors look at both the ex ante household level preparedness for flood events and the ex post availability of community-level support and disaster relief. The authors find somewhat paradoxically that the people that face the highest risk of flooding are the least well prepared, both in terms of household-level ex ante preparedness and community-level ex post flood relief.

Ebi, Kristie L., David M. Mills, Joel B. Smith, and Anne Grambsch. 2006. Climate change and human health impacts in the United States: An update on the results of the U.S. national assessment. *Environmental Health Perspectives* 114(9): 1318-24.

The health sector component of the first U.S. National Assessment, published in 2000, synthesized the anticipated health impacts of climate variability and change for five categories of health outcomes: impacts attributable to temperature, extreme weather events (e.g., storms and floods), air pollution, water- and food-borne diseases, and vector- and rodent-borne diseases. The Health Sector Assessment (HSA) concluded that climate variability and change are likely to increase morbidity and mortality risks for several climate-sensitive health outcomes, with the net impact uncertain. The objective of this study was to update the first HSA based on recent publications that address the potential impacts of climate variability and change in the United States for the five health outcome categories. The literature published since the first HSA supports the initial conclusions, with new data refining quantitative exposure-

response relationships for several health end points, particularly for extreme heat events and air pollution. The United States continues to have a very high capacity to plan for and respond to climate change, although relatively little progress has been noted in the literature on implementing adaptive strategies and measures. Large knowledge gaps remain, resulting in a substantial need for additional research to improve our understanding of how weather and climate, both directly and indirectly, can influence human health. Filling these knowledge gaps will help better define the potential health impacts of climate change and identify specific public health adaptations to increase resilience.

Moser, Susanne C., and John Tribbia. 2006-2007. Vulnerability to inundation and climate change impacts in California: Coastal managers' attitudes and perceptions. *Marine Technology Society Journal* 40(4): 35-44.

Coastal California has witnessed persistent sea-level rise (10–20 cm) along its southern and central open ocean coastal sections and in San Francisco Bay over the past century. This paper aims to understand the perceptions of local coastal managers in California of current inundation-related risks, the added risks from climate change, and vulnerability to the growing coastal problems. The authors also explore the extent to which coastal managers are beginning to think about and tackle these increasing management challenges. Survey results presented here suggest that inundation already creates critical management challenges in California, but other, non-inundation-related coastal problems also vie for managers' attention. Despite high awareness of global warming and moderately good understanding of potential impacts of climate change on coastal areas, currently pressing issues and limited staff time and resources constrain their ability to begin dealing with the growing risks from sea-level rise. The sobering conclusion is that California is inadequately preparing for the impacts of climate change on coastal areas at this time. Local government will need substantial support from state and federal agencies if the level of preparedness for climate change and other inundation-related risks is to be elevated in the future.

Takahashi, Kiyoshi, Yasushi Honda, and Seita Emori. 2007. Assessing mortality risk from heat stress due to global warming. *Journal of Risk Research* 10(3): 339-54.

With gradually progressing climate change in the future, the frequency and scale of hot summers like those observed in various places around the world in recent years will undoubtedly increase, giving rise to strong concerns over increased risk of death due to heat stress. Based on this background, we have developed a method to assess future changes in mortality due to heat stress with the entire globe as the target, and performed trial calculations using this method. The purpose of this report is to draw people's attention to the possible severe consequences of climate change by presenting the severest estimates in the uncertainty range due to adaptation/acclimation expected in the future, so as to induce further analysis and discussion on policies and measures. For the trial calculations, future changes in temperature were derived from the results of

simulation using an Atmosphere-Ocean General Circulation Model with the highest spatial resolution in the world at the time of the study. Population densities were assumed not to alter in the future. Assuming that no adaptation or acclimation takes place, when the rates of change of excess mortality due to heat stress are examined by country, the results of our calculations show increases of approximately 100% to 1000%. It is confirmed that the burden of climate change impact is quite unequal among countries, at least from the viewpoint of heat stress mortality. When considered together with present population densities, significant increases in excess mortality density can be seen in China, India, and Europe. These regions are characterized by large losses due to climate change in absolute quantitative terms. The need to consider the adoption of adaptation measures is therefore most urgent in these regions.

Critical Infrastructure

Clark, Andrew M. 2006-2007. On developing disaster resilient communications infrastructure. *Marine Technology Society Journal* 40(4): 17-34.

The August 29, 2005, landfall of Hurricane Katrina on the U.S. Gulf Coast revealed a number of local, regional, state, and national shortcomings. Destruction of communications infrastructure hindered emergency response during and immediately after the storm and further contributed to a lagging recovery and rebuilding process. While critical of some government agencies' actions, *The Federal Response to Hurricane Katrina Lessons Learned Report* compiled by the White House specifically cited the vital role that the U.S. private sector played through their voluntary response. This paper explores the response by some of the U.S. communications technology industry. Detailed are some of the technologies that were deployed and how each was employed to re-establish communication lifelines during the Katrina recovery effort. While simple good luck is attributed to facilitating the positive outcomes described, recommendations are provided that would ensure flexible solutions are in place for future disaster response operations to facilitate timely restoration of communications infrastructure. Though the focus of this paper is on destruction caused by coastal inundation, these solutions are applicable to other natural disasters, accidents, and acts of terrorism.

Disaster and Emergency Management

Bean, Hamilton, and Lisa Keranen. 2007. The role of homeland security information bulletins within emergency management organizations: A case study of enactment. *Journal of Homeland Security and Emergency Management* 4(2).

Homeland security information bulletins from governmental, commercial, and non-governmental providers are an important source of threat information within local emergency management organizations. This

article examines how e-mail-based homeland security information bulletins influenced preparedness in one university's emergency management organization. A one-year field study of the university's emergency management meetings, supplemented by in-depth interviews, survey data, and textual analysis, was used to determine how participants made sense of and communicated about homeland security threats. Assumptions about communication obscure the influence of bureaucratic imperatives in shaping "enactment" of homeland security threats. Process changes may be needed in order to enhance the contributions of homeland security information bulletins to emergency preparedness.

Berkes, Fikret. 2007. Understanding uncertainty and reducing vulnerability: Lessons from resilience thinking. *Natural Hazards* 41(2): 283-95.

Vulnerability is registered not by exposure to hazards alone; it also resides in the resilience of the system experiencing the hazard. Resilience (the capacity of a system to absorb recurrent disturbances, such as natural disasters, so as to retain essential structures, processes, and feedbacks) is important for the discussion of vulnerability for three reasons: 1) it helps evaluate hazards holistically in coupled human-environment systems; 2) it puts the emphasis on the ability of a system to deal with a hazard, absorbing the disturbance or adapting to it; and 3) it is forward-looking and helps explore policy options for dealing with uncertainty and future change. Building resilience into human-environment systems is an effective way to cope with change characterized by surprises and unknowable risks. There seem to be four clusters of factors relevant to building resilience: 1) learning to live with change and uncertainty; 2) nurturing various types of ecological, social and political diversity for increasing options and reducing risks; 3) increasing the range of knowledge for learning and problem-solving; and 4) creating opportunities for self-organization, including strengthening of local institutions and building cross-scale linkages and problem-solving networks.

Burton, Gareth. 2007. How the United States is reducing its firefighter fatalities. *Australian Journal of Emergency Management* 22(2): 37-43.

On average 100 firefighters lose their lives in the line of duty each year in the United States. Review of the data indicates that the number of firefighter deaths in recent years is less than the number of firefighter fatalities in the late 1980s. However when the data are considered with regard to the number of emergency calls, it is found that the number of firefighter deaths per call has increased. In 2004, a goal was established at the Life Safety Summit to reduce firefighter deaths within the United States by 25 percent within 5 years and by 50 percent within 10 years. This article discusses initiatives that have been implemented in an attempt to bring about the desired reduction.

Carr, Thomas Lyons. 2007. A study of local governments participating in the pre-disaster mitigation (PDM) program and populations served. *Journal of Homeland Security and Emergency Management* 4(2).

There are possibly 87,525 local governments that may be eligible to participate in local FEMA-Approved Multi-Hazard Mitigation Plans and the Pre-Disaster Mitigation (PDM) program. These include special single-purpose government entities that may not provide essential health and safety services of a governmental nature, whose eligibility is determined by the state. This study was limited to identifying the populations served by these local plans. As of mid-August 2005, 51 of the 58 state entities had local plans. This documentation review revealed there were only 1,139 of the congressionally mandated local approved plans with 5,793 participating jurisdictions representing only 37.44 percent of the nation's population. Ten state entities' local approved plans covered 69 percent or greater of the state's population and only five out of that ten were able to achieve of 88% or greater. The lower quartile's performance pre-Katrina and post-Katrina is examined. The low adoption rate, whether caused by multiple philosophies misinterpretations, or limited local capacity, capability, competence, or support, must be determined by more in-depth research. However, it was noted that the Pre-Disaster Mitigation (PDM) program guidance was more focused on pre-disaster mitigation strategies and competitive cost-effective projects than all-hazards risk and vulnerability assessments. To determine if a local or state PDM project will be cost-effective and maximize the benefits to the nation, these assessments must be completed first for all local counties and all hazards.

Haque, C. Emdad, and David Etkin. 2007. People and community as constituent parts of hazards: The significance of societal dimensions in hazards analysis. *Natural Hazards* 41(2): 271-82.

Nature-triggered hazards and disasters have traditionally been treated only from the lens of geophysical and biophysical processes, implying that the root cause of large-scale death and destruction lies in the natural domain rather than in a coupled human-environment system. Conceptually, the physical domain has been seen as discrete and separate from human entities, and solutions were sought in the technological intervention and control of the physical environment—solutions that often ended up being less effective than hoped for and sometimes even counter productive. At all levels, institutions have directed and redirected most of their financial and logistical resources into the search for scientific and engineering solutions without allocating due attention and resources towards the assessment of effects and effectiveness of the applications of such technological outcomes. However, over the last two decades, forceful criticisms of the 'dominant' technocratic approach to hazards analysis have appeared in the literature and consequently there has not only been a shift in thinking of causation of disaster loss in terms of human vulnerability, but also newer questions have arisen regarding distinguishing between the 'physical exposure' of people to threats and societal vulnerability, and linking them with propensity to hazards loss. Though the vulnerability/resilience paradigm has largely replaced the hazards paradigm within the social sciences and much of the professional emergency and disaster management

communities, this shift of thinking has not progressed to much of the physical science community, decision makers, and the public, who have not yet accepted the idea that understanding and using human and societal dimensions is equally or more important than trying to deal and control nature through the use of technology. This special issue is intended to further the idea that the aspects of community and peoples' power to mitigate, to improve coping mechanisms, to respond effectively, and to recover with vigor against the environmental extremes are of paramount conceptual and policy importance.

Harmon, Judy L. 2007. The effect of planning, training, and exercises on citizen preparedness. *Journal of Emergency Management* 5(2): 22-6.

Holowashuk, Brock. 2007. A framework for consensus, cooperation, and progress: The role of Canada's Council of the Federation in building a national strategy for emergency management. *Journal of Emergency Management* 5(3): 19-24.

In July 2004, Canada's Premiers expressed their priorities for emergency management at a meeting of the Council of the Federation. Provincial/territorial officials developed a set of priorities through a process of discussion and consensus, and these priorities were subsequently endorsed by the Premiers and accepted by the federal government, resulting in the development of a plan of action to address the Premiers' priorities, along with other matters of mutual concern. This article discusses the process by which a provincial/territorial consensus was formed, and how this executive direction has led to a plan of action and meaningful improvements to emergency management and public safety in Canada. It demonstrates how a proactive and cooperative approach to emergency management policy can lead to tangible operational improvements.

Kapucu, Naim, Wendell C. Lawther, and Sommer Pattison. 2007. Logistics and staging areas in managing disasters and emergencies. *Journal of Homeland Security and Emergency Management* 4(2).

Emergency management is often evaluated and improved after the occurrence of a disaster, especially in the case of preparedness. This paper discusses the importance of logistics planning and operation as it relates to disaster preparedness. The selection of field logistics sites, such as staging areas, prior to the occurrence of a natural or human-induced disaster, is a crucial step in emergency planning and management. Selection can be aided and kept consistent by pre-identifying state- and county-level guidelines for staging areas. This paper reviews state and county criteria for the pre-selection of staging areas and discusses supporting logistical operations in disaster management.

Khan, Mizan R., and M. Ashiqur Rahman. 2007. Partnership approach to disaster management in Bangladesh: A critical policy assessment. *Natural Hazards* 41(2): 359-78.

The geographic location of Bangladesh at the confluence of the three mighty river systems of the world renders her one of the most vulnerable places to natural disasters. Human-

induced climate change exacerbates the problem. This study shows that the Government of Bangladesh has already established a multi-layered institutional mechanism for disaster management, with formal recognition of the role of various stakeholders. Historically, non-governmental organizations (NGOs) and other informal support mechanisms in the country also have made significant contributions during and after disaster recovery. Despite the presence of some strengths, such as long experience in disaster response and recovery, the people's resilience, and donor support, the current management strategies suffer from a host of policy and institutional weaknesses. Most prominent is the absence of a functioning *partnership* among the stakeholders within these formal set-ups. What is lacking is the development and embodiment of a culture of *collective decision making* in planning, in resource sharing, and in implementing disaster management policies and programs in an integrated and transparent way. The paper suggests a partnership framework to implement prevention, preparedness, response, and recovery phases of disaster management.

Maguire, Brigit, and Patrick Hagan. 2007. Disasters and communities: Understanding social resilience. *Australian Journal of Emergency Management* 22(2): 16-20.

Social resilience is the capacity of social groups and communities to recover from, or respond positively to, crises. In this paper, the authors review the multifaceted nature of social resilience, and how this capacity is thought to have various properties, notably resistance, recovery and creativity. Also discussed is the idea that social groups within a community differ insofar as their levels of resilience and the threats to which they are resilient. While research in the social sciences suggests that social resilience is a 'naturally emergency' response to disaster, it is argued that emergency management plans must recognize and build on this capacity, and that improved indicators of social resilience are a priority area for future research.

McEntire, David A., and Abraham David Benavides. 2007. Learning in emergency management. *Journal of Emergency Management* 5(3): 17-18.

Nicolopoulos, Nick, Peter Damcevski, Jill Tomlinson, and Roger Lye. 2007. Emergency Management Information Development Plan (EMIDP). *Australian Journal of Emergency Management* 22(2): 49-56.

Pande, Rajnish, and Ravindra K. Pande. 2007. Resettlement and rehabilitation issues in Uttaranchal (India) with reference to natural disasters. *Disaster Prevention and Management* 16(3): 361-69.

The purpose of this paper is to devise Uttaranchal's disaster management mechanism for reduction of effects of disaster (i.e., damage to property and loss of life and the rapid and effective rescue, relief, and rehabilitation of the victims). Uttaranchal's location and geographical features render it vulnerable to minor changes. Hence any activity disapproved by mountain ecosystem triggers a disaster. One cannot stop disaster happening but can certainly take some

steps to reduce its effects. If disasters cannot be averted, then reduction of losses of any type caused by disaster becomes a focal point of the policy for disaster management. The study reveals that 83 villages in Uttaranchal need rehabilitation, but, to date, Uttaranchal has no resettlement and rehabilitation policy. In India, only three states—Maharashtra, Madhya Pradesh, and Punjab—have statewide resettlement and rehabilitation (R&R) policies. Other states have issued government orders or resolutions, sometimes sector-wide but more often for specific projects. The study is based on secondary data; however, sufficient care has been taken to consider all important factors while suggesting a rehabilitation policy for Uttaranchal State. A disaster of rare severity requires a high level of resettlement and rehabilitation assistance from the state. Sound resettlement and rehabilitation policy helps the government to tackle the problem immediately and efficiently. The study suggests a resettlement and rehabilitation policy for Uttaranchal State.

In response to increasing concerns about the impact of disaster recovery work on responders, Pearson International Airport (PIA) in Toronto established Canada's first airport based 'critical incident stress team' in the fall of 1989. The original aim was to support the local airport community, particularly in the event of an air disaster. Over the 17 years of operation, the goals and services of the team have shifted, founded on emerging theory and evidence-based practices and in keeping with the changes in emergency management systems. The service component of the team expanded beyond emergency workers and airport personnel to families and friends of those affected by disaster; the nature of the service became broader and more prevention focused. In addition, a research and training component has been added with the intent of better addressing the needs of those affected by disaster.

Ranganathan, Nagarajan, Upavan Gupta, Rashmi Shetty, and Ashok Murugavel. 2007. An automated decision support system based on game theoretic optimization for emergency management in urban environments. *Journal of Homeland Security and Emergency Management* 4(2).

In the context of multiple emergencies occurring in an urban environment, it is important to perform a fair allocation and scheduling of emergency response units to each emergency, as human lives could be at risk. In this work, a multi-emergency management system based on a single step, non-cooperative, normal form game model and a Nash equilibrium-based optimization methodology is proposed. In the proposed system, each emergency event is represented as a player in the game who is competing with other players for the allocation of resource units that are available in limited quantities within a given urban perimeter. The Nash equilibrium-based methodology identifies a socially fair allocation of resources depending on various fairness criteria, like the demand by each emergency event and the criticality of the events. The fairness criterion is well modeled in the game theoretic setting, while the criticality of an event can be modeled as per the requirements of a specific emergency management system. Such a system will be useful in managing emergencies in small to medium urban settings. The proposed game theoretic methodology naturally models the emergency response and resource deployment problem in the framework of social fairness, which is pivotal in these scenarios. The Nash equilibrium solution is computed using the Terje Hansen's fixed-point algorithm. Experimental results are presented for various test cases and metrics are developed to establish the quantitative measure of fairness of the results. The proposed system can be used as a decision support tool for managing emergencies, or as a simulator for learning and training purposes.

Rozakis, Manolis. 2007. The cultural context of emergencies: Seeking for a(n) holistic approach on disaster management. *Disaster Prevention and Management* 16(2): 201-9.

This paper seeks to examine the level of cooperation among organizations with different backgrounds, professional and regulatory relations and self-perceptions for the purpose of efficiently managing a disaster. The theoretical concept of this paper is presented within the organizational framework of risk perception and culture, and the interrelation among the involved parties. It will be enriched with cultural theory and the social construction of risk perception, along with the classification of organizations, according to their tasks and structure, proposed by the Disaster Research Center (DRC). In addition, issues on blame, secrecy, decision making and authority, communication, and training involved in the respective cultural context are examined as the main causes that may prevent a(n) holistic approach to emergency management. On the other hand, the practical element of this study involves a case study analysis of the King's Cross Underground fire, in 1987. The outcome of operations and the 31 casualties reveal the cultural diversity among the involved agents in the managing of the respective disaster. The issue on "symbolic interaction" among agents may determine the institutional position of society during a disaster. This paper stresses the potential for isomorphic learning as the most significant issue on the cultural context of organizations during emergency operations. In this sense, future practice should embrace the concept of isomorphic learning, within the cultural context of organizations; additional efforts should focus on the mutual exchange of information, resources, and personnel among organizations, prior to a disaster. Finally, this paper offers insight to organizations in order to reduce the impact of cultural differences among them and enhance the issue of coordination during emergencies; it may serve the purpose of reducing human casualties by supporting a(n) holistic approach on disaster management.

Regehr, Cheryl, Ted Bober, and Deane Johannis. 2007. Development and evolution of a crisis support service at an international airport. *International Journal of Emergency Management* 4(2): 239-49.

Scanlon, Joseph. 2007. Convergence unlimited: Overloaded call centers and the Indian Ocean tsunami. *International Journal of Emergency Management* 4(2): 211-38.

In the wake of the 2004 Indian Ocean tsunami, hundreds of thousands of persons all over the world called their foreign ministries to report that they were concerned their loved ones were among the victims. There were so many calls that most Foreign Ministry call centers were overwhelmed—in short, there was worldwide information convergence. Though all call centers had problems, some fared better than others, sometimes because they had more experience or better planning, sometimes because they had a good back-up system, or because they had a recording informing callers what information would be needed so callers were prepared when they did get through. In one case, the problems were fewer because the incident occurred the day after Christmas day, which is a holiday in Christian countries but was a normal working day in Israel. Two countries—Canada and the Netherlands—used a computer-based system designed by a Canadian company, World Reach Software, intended for precisely this type of crisis. It functioned well. There is no way to prevent calls in the wake of such destructive events but a review of what happened in nine countries—Israel, the Netherlands, the UK, Denmark, Norway, Sweden, Canada, Australia, and New Zealand—suggests that some lessons were learned and that planning could be improved.

Sturgis, Rhonda. 2007. Strategic planning for emergency managers. *Journal of Emergency Management* 5(2): 41-48.

Waugh, William L. 2007. The principles of emergency management. *Journal of Emergency Management* 5(3): 15-16.

Disaster Relief

Pande, Rajnish, and Ravindra K. Pande. 2007. Financial mechanism for the relief expenditure in India: Some observations. *Disaster Prevention and Management* 16(3): 353-60.

This paper proposes to study institutional financial arrangements in India at national, state, and district levels for providing relief and rehabilitation to the affected persons during natural hazards. India's location and geographical features render it vulnerable to a number of natural hazards, such as cyclone, drought, floods, earthquakes, landslides, etc. The government and people have learned a lot of lessons from the past experiences and have developed a financial system to provide relief to affected persons during/after natural disasters. For seeking assistance from the National Fund for Calamity Relief (NFCR), the concerned state government is required to send a memorandum, indicating in detail the sector-wise damage, requirements of funds from NFCR, etc. Lack of information, in most of the cases, leads to delay in processing the requests of the state government. The study is based on the data/information collected for the last 10 years (1995-2005). The period is short for developing any hypothesis, but sufficient care has been taken to consider vital factors. A calamity of rare severity requires a high level of relief assistance from the state. Sound financial mechanism helps the government to tackle the problem immediately and efficiently. The study highlights shortcomings in the financial mechanism for relief in India and suggests steps to overcome them.

Pinera, Jean-Francois, and Robert A. Reed. 2007. Maximizing aid benefits after urban disasters through partnerships with local water sector utilities. *Disaster Prevention and Management* 16(3): 401-11.

The purpose of this article is to review the status of current research on how disaster response can best adapt to the urban environment. It looks specifically at water supply assistance, analyzing the role and interaction of the various stakeholders and, in particular, the relationship between aid agencies and water utilities. The review is based on published and unpublished documents produced on the response to emergencies having taken place in developing countries in the last 30 years. The article reproduces statistical data on the rising trends in the incidence of disasters in cities, which emphasizes the relevance of the subject. It also shows that the experience accumulated in the last decade on the response to urban disasters suggests that partnerships between water utilities and aid agencies are beneficial. But the means to achieve this partnership require a more in-depth analysis. This review is based only on the literature and should be completed by a case study research in order to support and further develop its theses. While the level of access to urban services in the developing countries has been extensively researched in "normal times," there has been little exploration of its role in crisis situations. This article points out the value of such research and recommends that more analysis is carried out.

Earthquakes

Azzaro, R., F. Bernardini, R. Camassi, and V. Castelli. 2007. The 1780 seismic sequence in NE Sicily (Italy): Shifting an underestimated and mislocated earthquake to a seismically low rate zone. *Natural Hazards* 42(1): 149-67.

The southernmost sector of the Italian peninsula is crossed by an almost continuous seismogenic belt capable of producing M7 earthquakes and extending from the Calabrian Arc, through the Messina Straits, as far as southeastern Sicily. Though large earthquakes occurring in this region during the last millennium are fairly well known from the historical point of view and seismic catalogues may be considered complete for destructive and badly damaging events, the knowledge and seismic completeness of moderate earthquakes can be improved by investigating other kinds of documentary sources not explored by the classical seismological tradition. In this paper, the authors present a case study explanatory of the problem, regarding the Ionian coast between the Messina Straits and Mount Etna volcano, an area of northeastern Sicily lacking evidence of relevant seismic activity in historical times. Now, after a systematic analysis of the 18th century journalistic sources (gazettes), this gap can be partly filled by the rediscovery of a seismic sequence that took place in 1780. According to the available catalogues, the only event on record for this year is a minor shock recorded in Messina on March 28, 1780. The newly discovered data allow it to reinstate it as the mainshock of a significant seismic period, which went on from March to June 1780, causing severe damage along the Ionian coast of northeastern Sicily. The source responsible

for this event appears to be located offshore, 40 kilometers south of the previous determination, and is consistent with the Taormina Fault suggested by the geological literature, developing in the low seismic rate zone at the southernmost termination of the 1908 Messina earthquake fault.

Bakir, Pelin Gunders, Guido De Roeck, Geert Degrande, and Edwin Reynders. 2007. Seismic demands and analysis of site effects in the Marmara region during the 1999 Kocaeli earthquake. *Natural Hazards* 42(1): 169-91.

The characteristics of the strong ground motion accelerograms from the 1999 Kocaeli earthquake are investigated in detail in this study. The emphasis is on the comparison of the response spectra for the fault normal (FN) and fault parallel (FP) components of the ground motions. The results show that the near-fault records with directivity effects characterize themselves with increased base shear demands rather than increased displacement demands for both the FN and FP components and a narrower velocity sensitive region for the FN component. This study also shows that the effectiveness of base isolation may vary from site to site and for a given site, from component to component. The site effects in the Marmara region during the 1999 Kocaeli earthquake are examined. Site amplifications are predicted by the classical spectral ratio (CSR) and the receiver function (RF) methods. The CSR method gives higher estimates for the site amplifications compared to the RF method and is in better conformity with the observed damage during the Kocaeli earthquake. The districts of Istanbul that are especially susceptible to site amplification hazard are determined. It is apparent from the results that the site amplification hazard risk is the highest for Avcilar and Bakirkoy districts. This study also shows that for sites that have the risk of soil amplification for long-period structures, liquefaction may not be beneficial as a natural base isolator, and may result in shifting the eigenperiod of the low- and mid-rise structures to the critical periods with high site amplifications. This may be especially the case for Avcilar and Bakirkoy districts. In Fatih, Bakirkoy, and Cekmece districts, the predominant period of the ground motion is calculated to be very close to the eigenperiods of the typical residential buildings. Therefore, these three districts are expected to experience heavier damages in future earthquakes due to resonance effects.

Jafari, Mohammad Ashtari. 2007. Time independent seismic hazard analysis in Alborz and surrounding area. *Natural Hazards* 42(1): 237-52.

The Bayesian probability estimation seems to have efficiencies that make it suitable for calculating different parameters of seismicity. Generally this method is able to combine prior information on seismicity while at the same time including statistical uncertainty associated with the estimation of the parameters used to quantify seismicity, in addition to the probabilistic uncertainties associated with the inherent randomness of earthquake occurrence. In this article, a time-independent Bayesian approach, which yields the probability that a certain cut-off magnitude will be exceeded at certain time intervals, is examined for the region of Alborz, Iran, in order to consider the following

consequences for the city of Tehran. This area is located within the Alpine-Himalayan active mountain belt. Many active faults affect the Alborz, most of which are parallel to the range and accommodate the present day oblique convergence across it. Tehran, the capital of Iran, with millions of inhabitants, is located near the foothills of the southern Central Alborz. This region has been affected several times by historical and recent earthquakes that confirm the importance of seismic hazard assessment through it. As the first step in this study, an updated earthquake catalog is compiled for the Alborz. Then, by assuming a Poisson distribution for the number of earthquakes that occur at a certain time interval, the probabilistic earthquake occurrence is computed by the Bayesian approach. The highest probabilities are found for zone AA and the lowest probabilities for zones KD and CA, meanwhile the overall probability is high.

Pai, Chih-Hung, Yong-Ming Tien, and Ta-Liang Teng. 2007. A study of the human-fatality rate in near-fault regions using the Victim Attribute Database. *Natural Hazards* 42(1): 19-35.

After the 1999 Chi-Chi earthquake, the Taiwanese government immediately issued new guidelines prohibiting the construction of structures for human occupancy within the Chelungpu fault zone. However, these guidelines were not based upon an in-depth hazard analysis of the near-fault regions. The positions of more than 80 percent of the 2,492 victims of the Chi-Chi earthquake were found by our research team. A Victim Attribute Database has been compiled that includes the GPS coordinates of the positioned victims, as well as other attribute data associated with the victims. The human-fatality rates in the near-fault regions have been analyzed with regard to distances from the Chelungpu fault, the hanging-wall and footwall areas, and building type. The severity at the human-fatality rates in the near-fault regions is inversely proportional to distances from the causative fault (i.e., the closer the distance, the higher the human-fatality rate observed). The human-fatality rate for victims who lived in closer proximity to the hanging-wall areas is also significantly higher than those who lived in closer proximity to the footwall areas, especially in areas on either side of the fault and within 1,000 meters of the fault surface trace. In terms of different building types, factors that include the capacity of the buildings to resist strong shaking and the level of strong ground motion greatly affected the human-fatality rates in the hanging-wall and footwall areas. Therefore simply prohibiting the construction of buildings within the active fault zone would be an insufficient method of reducing the number of potential victims; a nationwide effort should be undertaken to upgrade the capacity of buildings to resist strong shaking.

Toprak, Selcuk, and Filiz Taskin. 2007. Estimation of earthquake damage to buried pipelines caused by ground shaking. *Natural Hazards* 40(1): 1-24.

One of the most critical lessons of the recent earthquakes is the need for seismic planning for lifelines, with appropriate supplies and back up systems for emergency repair and restoration. Seismic planning, however, requires physical

loss estimations before the earthquakes occur. Buried pipeline damage correlations are critical part of loss estimation procedures applied to lifelines for future earthquakes. This article reviews the existing pipeline damage relationships only for ground shaking (transient ground deformations) in the light of recent developments and evaluate them with Denizli City, Turkey, water supply system. Eight scenario earthquakes with four different earthquake magnitudes between M6 and M7 caused by two different fault ruptures (Pamukkale and Karakova-Akhan Faults) were used. Analyses were performed by using geographical information systems (GIS). This high number of different scenario earthquakes made it possible to compare the pipeline damage relationships at different ground shaking levels. Pipeline damage estimations for Denizli City were calculated for each damage relationship and earthquake scenario. Relative effects of damage relationships and scenario earthquakes on the results were compared and discussed. The results were presented separately for brittle, ductile, and all pipelines. It was shown that the variation in ductile pipeline damage estimations by various relationships was higher than the variation in brittle pipeline damage estimations for a particular scenario earthquake.

Floods

Barredo, Jose I. 2007. Major flood disasters in Europe: 1950–2005. *Natural Hazards* 42(1): 125-48.

There is a need for comprehensive, standardized, and georeferenced information on floods for political and economic decision making. Relevant, accurate, and up-to-date data are important for resource distribution, mitigation programs, disaster monitoring, and assessment. Despite this, there is a lack of spatial and thematic accurate global data for floods. In Europe, historic data on flood losses and casualties are neither comprehensive nor standardized, thus making long-term analyses at the continental level difficult. In this article, we present a map and catalog of the major flood events of the last 56 years in the European Union (EU), Bulgaria, and Romania. This study is an effort to alleviate the lack of homogeneous and georeferenced information on flood disasters for large periods in Europe. The objectives of this paper are to identify and classify the major flood disasters of the last 56 years in the EU, to map the major flood disasters at pan-European scale with the support of a potential flood hazard map and ancillary GIS datasets, and to give a picture of the current situation for major floods in the EU on the basis of past events and current trends. The Emergency Events Database (EM-DAT) of the Centre of Research on Epidemiology of Disasters (CRED) in Brussels and U.S. Office for Foreign Disaster Assistance (OFDA) and NATHAN of Munich Re are two of the main public global databases for natural disasters. Information from EM-DAT and NATHAN on flood disasters producing more than 70 casualties and/or more than 0.005 percent of EU gross domestic product in damage has been assessed for the production of the map and catalogue of major flood disasters in Europe.

Escalante-Sandoval, Carlos. 2007. Application of bivariate extreme value distribution to flood frequency analysis: A case study of Northwestern Mexico. *Natural Hazards* 42(1): 37-46.

In Mexico, poverty has forced people to live almost on the water of rivers. This situation, along with the occurrence of floods, is a serious problem for the local governments. In order to protect their lives and goods, it is very important to account with a mathematical tool that may reduce the uncertainties in computing the design events for different return periods. In this paper, the Logistic model for bivariate extreme value distribution with Weibull-2 and Mixed Weibull marginals is proposed for the case of flood frequency analysis. A procedure to estimate their parameters based on the maximum likelihood method is developed. A region in Northwestern Mexico with 16 gauging stations has been selected to apply the model and regional at-site quantiles were estimated. A significant improvement occurs, measured through the use of a goodness-of-fit test, when parameters are estimated using the bivariate distribution instead of its univariate counterpart. Results suggest that it is very important to consider the Mixed Weibull distribution and its bivariate option when analyzing floods generated by a mixture of two populations.

Hung, Hoang Vinh, Rajib Shaw, and Masami Kobayashi. 2007. Flood risk management for the RUA of Hanoi: Importance of community perception of catastrophic flood risk in disaster risk planning. *Disaster Prevention and Management* 16(2): 245-58.

This paper aims to investigate reasons for unusual overdevelopment of floodplain areas outside river dykes, provides an insight into the importance of community perception of catastrophic flood risk in the riverside urban areas (RUA) of Hanoi, and establishes the need for participatory disaster management planning and disaster management education in the study location. A structured survey was conducted in five wards in the RUA to understand how residents perceived flood risk. The low perception of catastrophic flood risk among communities was found to be an important factor in the continued development of the RUA and led to the trust in houses as a prominent protective solution. Moreover, the flood vulnerability of the areas has been increasing due to the missing link between local authorities and community. This paper examines community perception of flood risk as one of the main factors. Other factors, such as availability of options for housing, public participation, and relevant policy interventions, are beyond the scope of the paper and need to be studied in the same location. To regulate the development of the RUA, community perception of catastrophic flood risk should be changed and community leaders should be motivated, with involvement of local authority at ward offices, to conduct comprehensive hands-on community education programs. Little research has been done on the overdevelopment and community perception in the flood-prone areas. This paper not only reaffirms the few studies made in the past but also suggests broad interventions for enhancing the flood risk perception among the community members.

Mahdi, T. 2007. Pairing geotechnics and fluvial hydraulics for the prediction of the hazard zones of an exceptional flooding. *Natural Hazards* 42(1): 225-36.

The direct consequences of exceptional floods are usually considered to be limited to the maximum flooding zone created downstream. However, considering the magnitude of the flows, the morphology of the flooded zone could undergo deep changes. To predict the hazard zone on a river undergoing exceptional flooding, numerical simulations are widely used. In this article, the simulation of the evolution of river reaches resulting from such catastrophic events is performed by coupling the hydraulic and sediment transport numerical model GSTARS with a developed slope stability model based on the Bishop's simplified method. This is a novel methodology for the delimitation of hazard zones along riverbanks by taking into consideration not only the flood risks but also the possible induced landslides. Indeed, each section of the river reach is subject to changes caused by the river hydraulics and the associated erosion or sediment deposition and also undergoes profile changes caused by possible landslides. The initial hydraulic and geotechnical characteristics are first defined and then used to test the stability of several slopes of representative sections of the river reaches before the dam break. Validation tests are performed on specific reaches of the Outaouais River (Quebec) undergoing a dam break flood.

Perumal, Muthiaj, and Bhabagrahi Sahoo. 2007. Limitations of real-time models for forecasting river flooding from monsoon rainfall. *Natural Hazards* 42(2): 415-22.

Very intense rainfall during the southwest and northeast monsoons causes severe flooding in India. Some traditional techniques used for real-time forecasting of flooding involve the relationship between effective rainfall and runoff processes. There are, however, serious problems in deducing these variables in real time, so it is highly desirable to have a real-time flood forecasting model that would directly relate the observed discharge hydrograph to the observed rainfall. The storage routing model is used to compute observed river discharge directly from observed hourly rainfall. This method has been used to study rainfall-runoff data of the Ajay River Basin in eastern India. It seems the models will yield accurate hindcast if the rainfall is uniform over the drainage basin. When the rainfall is not uniform, the performance of the model is unsatisfactory. In the future this problem can, in principle, be corrected by using a weighted amount if rainfall is based upon multiple rain-gauge observations over the drainage basin. This would provide some measure of the dispersion in the rainfall. The model also seems unable to simulate flooding events with multiple peaks.

Shrubsole, Dan. 2007. From structures to sustainability: A history of flood management strategies in Canada. *International Journal of Emergency Management* 4(2): 183-96.

Four principles are identified as being associated with sustainability—balance, ecosystem approach, adaptive management, and teamwork. The evolution of flood management strategies in Canada is provided using

secondary historical sources. The sustainability of flood management, in Canada is assessed in terms of the nature and extent to which flood management strategies exhibit principles of balance, ecosystem approaches, adaptive management and teamwork. The paper concludes that while Canada's National Disaster Mitigation Strategy (NDMS) has made progress towards achieving sustainability, there are specific considerations that require further attention.

Spencer, Jeffrey, and Rick Myer. 2007. A population and economic overview of Cambria County, Pennsylvania, following the 1977 Johnstown Flood. *Disaster Prevention and Management* 16(2): 259-64.

This paper seeks to examine the extent of monetary damage, the loss of life, and the effect on employment caused by the 1977 Johnstown Flood and subsequent effects on population, unemployment rate, poverty rate, per capita income, median household income, and education in Cambria County, Pennsylvania. Statistics from 1980, 1990, and 2000 were used to create an economic and population overview of Cambria County. Short-term and long-term effects of the 1977 flood were examined to uncover possible trends regarding population and economics. Revealed trends might aid communities in recovering following a natural disaster. There have been continuous decreases in population following the 1977 Johnstown Flood and a drastic increase in the unemployment rate following the flood. These findings suggest that the loss of key employers following a major natural disaster may lead to long-term losses in the overall population. These data relate to only Cambria County and may not relate to other areas. Implications suggest that following a similar natural disaster, crisis counselors may aid community governments in rebuilding economic infrastructures and career counselors could assist displaced workers with retraining and job-seeking. This paper begins to explore the relationship between natural disasters and population changes.

Wagner, Klaus. 2007. Mental models of flash floods and landslides. *Risk Analysis* 27(3): 671-82.

Perceptions of flash floods and landslides were analyzed in four communities of the Bavarian Alps using the mental model approach. Thirty-eight qualitative interviews, two telephone surveys with 600 respondents, and two onsite interviews (74 and 95 respondents) were conducted. Mental models concerning flash floods are much better developed than those for landslides because the key physical processes for flash floods are easier for the general public to recognize and understand. Mental models are influenced by the local conditions. People who have a better knowledge about the hazards are those who use many different sources to inform themselves, express fear about natural hazards, or have previous experience with hazards. Conclusions for how to improve information for the general public are discussed.

Gender and Vulnerable Populations

Borden, Kevin A., Matthew C. Schmidlein, Christopher T. Emrich, Walter W. Piegorsch, and Susan L. Cutter. 2007. Vulnerability of U.S. cities to environmental hazards. *Journal of Homeland Security and Emergency Management* 4(2).

As cities continue to increase in size, population diversity, and complexity, their vulnerability to future disasters will increase as well. This paper explores the variability in vulnerability to natural hazards among the 132 urban areas using three indices of vulnerability: social, built environment, and hazard impact. The paper then examines the relative levels of vulnerability compared to federal Urban Area Security Initiative (UASI) funding. The paper demonstrates that vulnerability manifests itself as a place-based regional phenomenon, with the most vulnerable cities located in the eastern half of the United States. The relative importance of the underlying correlates changes from city to city across the United States, with social vulnerability assuming greater importance in the South and Southwest, and built environment vulnerability showing regional primacy as the driving indicator among Northeastern and Midwestern cities. Based on this empirical analysis, New Orleans was the most vulnerable urban area in the United States, yet it received only one percent of the preparedness resources awarded by the federal government.

Cupples, Julie. 2007. Gender and Hurricane Mitch: Reconstructing subjectives after disaster. *Disasters* 31(2): 155-75.

Much of the gender and disaster literature calls for more gender-sensitive disaster relief and research by focusing on the ways in which women are more vulnerable in a disaster or on their unique capabilities as community leaders or natural resource managers, which are often overlooked or underutilized in emergency management strategies. As well as seeking to overcome the (strategic) essentialism that is part of these calls and debates, this paper pays closer attention to gender identity and subjectivity as these are constructed and reworked through the disaster process to highlight the complexities and contradictions associated with women's responses to a disaster. This focus, while crucial to gaining a deeper understanding of the gendered dimensions of disaster, also complicates attempts to create more gender-sensitive frameworks for disaster response. It draws on qualitative research conducted with a number of women in the wake of Hurricane Mitch (1998) in Nicaragua.

Jones, Brenda, and Jean Andrey. 2007. Vulnerability index construction: methodological choices and their influence on identifying vulnerable neighborhoods. *International Journal of Emergency Management* 4(2): 269-95.

Indices are increasingly important for emergency planning at the community level, particularly with respect to identifying vulnerable neighborhoods and mapping disaster potential. This paper provides both a critical literature review and an empirical case study that highlight the importance of different types of decisions in the construction of vulnerability indices. The case study focuses on the

flooding risk in Vancouver, Canada, from both an evacuation and rebuilding perspective. Results of a sensitivity analysis suggest that spatial outcomes of vulnerability are highly sensitive to decisions regarding variable selection and representation, moderately sensitive to decisions about variable weighting, and minimally affected by decisions about variable scaling.

Laska, Shirley, and Betty Hearn Morrow. 2006-2007. Social vulnerabilities and Hurricane Katrina: An unnatural disaster in New Orleans. *Marine Technology Society Journal* 40(4): 16-26.

Social science research on natural disasters documents how a natural hazard such as a hurricane becomes a disaster through social processes and social structures that place human populations in general, and certain segments in particular, at risk. After a description of Hurricane Katrina and its impact, the authors describe how patterns of land development, and the economic and political history of New Orleans, set the stage for this disaster. An overview of past research findings on the relationship between citizen vulnerability and poverty, minority status, age and disability, gender, and tenancy is followed by evidence of the extent to which each risk factor was present in the pre-Katrina New Orleans population. The authors then cite evidence of how social vulnerability influenced outcomes at various stages of the Hurricane Katrina catastrophe, including mitigation, preparation, evacuation, storm impacts, and recovery. The concluding section discusses how the goal of disaster-resilient communities cannot be reached until basic issues of inequality and social justice are addressed.

Phillips, Brenda D., and Betty Hearn Morrow. 2007. Social science research needs: Focus on vulnerable populations, forecasting, and warnings. *Natural Hazards Review* 8(3): 61-68.

This paper assesses the state of social science research specific to populations at risk vis-à-vis weather forecasting and warnings. At-risk populations are defined as groups historically disadvantaged by socioeconomic status; patterns of discrimination and exclusion, or both; a lack of political representation; or cultural distancing. These contexts marginalize some groups, leaving them less likely to receive, interpret, and respond appropriately to forecasts and warnings. The authors give an overview of key concepts from vulnerability research and suggest research topics emanating from the social science literature relevant to forecasting and warnings.

Homeland Security and Terrorism

Lemyre, Louise, Jennifer E. C. Lee, Michelle C. Turner, and Daniel Krewski. 2007. Terrorism preparedness in Canada: A public survey on perceived institutional and individual response to terrorism. *International Journal of Emergency Management* 4(2): 296-315.

Although much effort has recently been expended on evaluating and improving terrorism preparedness among

Canadian federal, provincial, and local institutions, less attention has been given to understanding the public's view of these initiatives. The national public survey of perceived chemical, biological, radiological, and nuclear terrorism threat and preparedness was conducted specifically with this aim. Since emergency preparedness is considered a shared responsibility between governments, communities, and individuals in Canada, the survey assessed Canadians' views regarding the level of preparedness of institutions at all levels, as well as the extent to which they have personally taken measures to prepare for a possible attack. Findings reveal that respondents perceived governmental institutions as less prepared for terrorist events than emergency or response institutions. Respondents also reported having taken few measures to prepare for themselves. Perceptions of institutional preparedness and individual preparedness differed significantly by demographic groups, with many observed gender differences.

Murray-Tuite, Pamela. 2007. A framework for evaluating risk to the transportation network from terrorism and security policies. *International Journal of Critical Infrastructures* 3(3/4): 389-407.

Examining the risk imposed on the transportation network by both security policies and terrorist activity is critical to understanding higher-level risks, such as those related to national security and the economy. This paper presents a framework for evaluating risk to the road transportation network from direct targeting by terrorists, collateral damage, and pre-attack and post-attack security policies. Risk is measured in terms of capacity losses between an origin and a destination. An event tree determines the probabilities that the network's links are in particular states. The maximum flow between the OD pair, subtracted from the maximum flow of the baseline network, determines the consequences, or impact. Using this framework, decision makers can better evaluate the costs of both terrorist activities and security measures, including the risk of reacting to false intelligence.

Rogers, M. Brooke, Richard Amlot, G. James Rubin, and Simon Krieger Kristian Wessely. 2007. Mediating the social and psychological impacts of terrorist attacks: The role of risk perception and risk communication. *International Review of Psychiatry* 19(3): 279-88.

The public's understanding of chemical, biological, radiological, and nuclear (CBRN) related issues and their likely actions following a CBRN incident is an issue of great concern, as public psychological and behavioral responses will help determine subsequent morbidity and mortality rates. This paper explores the role of effective government communication with the public and its role in mediating the social and psychological impact of terrorist attacks. We examine the importance of effective communication in reducing morbidity and mortality in the event of a terrorist attack and explore the impact of risk perceptions in determining the success or failure of risk communication strategies. This includes the examination of the role of fear as a health risk and the identification of factors relevant to public trust in risk communication. Finally, an investigation

of the type of information desired by members of the public leads the authors to make risk communication recommendations targeted at the promotion of more adaptive behaviors in response to CBRN attacks.

Wells, Linton, and Barry M. Horowitz. 2007. Implementation of a methodology for the prioritizing of suicide attacker recruitment preferences. *Journal of Homeland Security and Emergency Management* 4(2).

Terrorist organizations are often difficult for policy makers to understand, a circumstance that is exacerbated when there is little consensus among the community of experts. This research presents a controlled way to prioritize differing explanations about terrorist organizations. As a case study, the authors examine the preferences of the organization Hamas when recruiting suicide attackers. Using two different data sets, one collected from past suicide attacker biographies, the other a survey of subject matter experts, the authors prioritized 10 categories of theories of recruitment in the West Bank from 2001-2005. Based on their analysis, the four factors found to be most important are, in no order of importance: religious influences, individual frustrations, personal economic motivations, and political/nationalistic motivations. In contrast, the six factors which are least important are: cultural motivations, personal revenge motivations, social network enablers, operational usefulness to the organization, small group dynamics, and internal psychological disorders. To minimize Hamas's recruitment effectiveness, countermeasures which align with the important factors will be more effective than those that do not.

Hurricanes and Coastal Hazards

Dalal, Jyotirmony, and Pratap K. J. Mohapatra. 2007. Locating cyclone shelters: A case. *Disaster Prevention and Management* 16(2): 235-44.

This paper aims to present the cyclone shelter location problem as a problem of grouping a set of villages into a minimum number of clusters and finding the location and capacity of the shelters. The paper proposes an algorithm to solve the location problem that uses a distance matrix of the villages, applies Elzinga-Hearn method iteratively to group them into circular clusters, and determines the shelter size. It is implemented in a software package, which reads the village records from a database, executes the steps of the algorithm, and writes the results into a file. The villages are grouped into 13 clusters, eight requiring cyclone shelters to be built and five requiring no shelter, taking into consideration the available space in double-storied buildings in the villages. The capacity and location of each shelter are also obtained. The approach can be modified to address several practical constraints. For example, for the villages situated far from the coast, limiting travel distance can be increased, considering that a lesser intensity cyclone would give more time to the villagers to reach the shelter. Funds are available from a number of public and private organizations to construct cyclone shelters, which could be used properly only when optimal locations for the cyclone

shelters are identified. Originality of the work lies in adapting Elzinga-Hearn method iteratively to group the villages into circular clusters and implementing the algorithm in software solution. The concerned authority, to take cyclone shelter location decisions, can use the software.

DeVoe, M. Richard, Earle Buckley, Jennifer Dorton, Madilyn Fletcher, Lynn Leonard, Parker Lumpkin, Christopher N. K. Mooers, Leonard J. Pietrafesa, Dwayne Porter, Harvey Seim, Susannah Sheldon, and Lian Xie. 2006-2007. Regional coastal IOOS development in the southeastern United States: Emerging capabilities to address coastal natural hazards. *Marine Technology Society Journal* 40(4): 110-17.

The Southeast Coastal Ocean Observing Regional Association (SECOORA) is maturing into an organization that can effectively coordinate the development and evolution of a comprehensive coastal ocean observing program for the Southeast U.S. Strategies are being developed to productively integrate the existing base of legacy assets (including observation systems and platforms, data analysis and management centers, research efforts, educational initiatives, and personnel) and the wide spectrum of current and potential stakeholders. There are many direct and indirect applications of the data and information derived from coastal ocean observing systems, and the issues related to coastal natural hazards are of particular interest in the southeastern U.S. Risks to life, property, and natural resources from natural hazard events will increase due to the projected increase in storm frequency and intensity and growth of the region's coastal population over the next several decades. Unprecedented hurricane damage and human despair that resulted from the 2005 hurricane season has tested government response at all levels, revealing unanswered questions regarding the level of our preparedness to deal with and respond to disasters of this magnitude.

Ebersole, Bruce A., Donald T. Resio, and Joannes J. Westerink. 2006-2007. A community approach to improved prediction and characterization of coastal storm hazards. *Marine Technology Society Journal* 40(4): 56-68.

This paper discusses the value of a community approach to characterizing the coastal storm hazard (e.g., hurricane water levels and wave conditions) through field measurements, data analysis, and modeling. Value is illustrated using experiences and results from recent and ongoing projects. One example is recently completed work by the Interagency Performance Evaluation Task Force (IPET), which was commissioned by the U.S. Army Corps of Engineers. The IPET was charged with gathering the facts regarding performance of the hurricane protection system in southeast Louisiana in response to Hurricane Katrina. A second example is ongoing work being lead by the Corps to design projects that can greatly reduce the likelihood and consequences of flooding for coastal Louisiana and Mississippi. These investigations are being closely coordinated with work of the Federal Emergency Management Agency to update flood insurance rate maps for the region. Findings and lessons learned are discussed,

and challenges in making accurate surge and wave predictions are identified, including: 1) inaccuracy in coastal and estuarine wind fields, 2) specification of a wind drag law in shallow coastal areas, and 3) problems in treating nearshore wave set-up and coupling into surge models. A new Corps research program that is addressing many of these issues, also a community effort, is described as are results from early progress in selected problem areas. The paper presents advantages to developing open-source, community-based computer software for coastal storm wave and surge predictions, and some problems with today's over-reliance on proprietary software.

Erickson, Mary, Paul Scholz, Fred Toepfer, and Marie Colton. 2006-2007. The community modeling approach. *Marine Technology Society Journal* 40(4): 69-70.

Gill, Stephen K., and Frank Aikman. 2006-2007. Oceanographic models as a tool for data integration. *Marine Technology Society Journal* 40(4): 78-85.

The use of the term "integration" in the oceanographic world is now ingrained in governmental infrastructure for strategic planning and program implementation. Indeed, the National Office for Integrated and Sustained Ocean Observations, Ocean.US, was formed in recognition of the requirements of an Integrated Ocean Observing System (IOOS). The topic of this contribution is more narrowly focused on improving models through data integration in the larger context of how models are applied and how they interplay with observations. The report from the U.S. Commission on Ocean Policy provides this context, along with conceptual planning documents for the various subsystems of IOOS developed by Ocean.US. Within the National Oceanic and Atmospheric Administration (NOAA), specific guidance on data integration is found in various program planning documents such as the NOAA Annual Guidance Memorandum. The NOAA Storm Surge Partnership Project is an excellent example of a program that is built on the requirement to integrate activities across NOAA, academia, and stakeholders, and has a nested data integration activity. Outside of NOAA, but within the IOOS umbrella structure, several regional observing system entities are developing their own tailored data integration activities. Finally, there are a significant number of research activities that are focusing on various assimilation and integration techniques, both for improving and expanding model applications and for optimizing the design of the observing systems themselves. We focus here on current coastal modeling and data integration activities to link existing work to the IOOS construct and goals and to discuss limitations and areas needing improvement.

Gladwin, Hugh, Jeffrey K. Lazo, Betty Hearn Morrow, Walter Gillis Peacock, and Hugh E. Willoughby. 2007. Social science research needs for the hurricane forecast and warning system. *Natural Hazards Review* 8(3): 87-95.

This article begins to identify high-priority social science research issues focused on the hurricane forecast and warning system. The research agenda was distilled as faithfully as possible from the efforts of a host of scientists.

These included a series of white papers; a workshop in Pomona, California, in February 2005; several sessions at the 2004 and 2005 Natural Hazards workshops held in Boulder, Colorado; and additional input from the broader social science research community unable to attend these events. Expected results from this effort are 1) a focused applied research agenda designed to generate short-term immediate benefits; 2) a broader, more basic research agenda addressing fundamental theoretical and exploratory research designed to generate long-term improvements; 3) methods to enable the social science research community to gather and further develop research priorities and future agendas; and 4) a concept for a long-term, multidisciplinary, institutional approach to undertaking identified research priorities. This paper is presented as a call to action for the appropriate agencies and organizations to support social science research on the high-priority issues in the hurricane forecast and warning system to meet societal goals of protecting lives and property in the face of the ever-present threat of hurricanes.

Jochens, Ann E., and Worth D. Nowlin. 2006-2007.

Development of a coastal ocean observing system for the Gulf of Mexico. *Marine Technology Society Journal* 40(4): 100-109.

The Gulf of Mexico Coastal Ocean Observing System (GCOOS) is being developed as one of the regional coastal ocean observing systems under the U.S. Integrated Ocean Observing System (IOOS), which is a contribution to the Global Ocean Observing System (GOOS). GCOOS will be a sustained ocean observing system that provides data, information, and products on marine and estuarine systems to a wide range of users. A GCOOS Regional Association (GCOOS-RA) has been established to develop GCOOS. Activities to build GCOOS have included development of an inventory of extant observing systems, connection of real-time physical data from extant systems into the National Data Buoy Center via the Internet, and establishment and implementation of mechanisms for ongoing identification of 1) stakeholder requirements and priorities and 2) priority pilot projects to meet regional needs. A storm surge and inundation workshop is being held to identify the measurements and products needed by emergency managers and responders to better predict and mitigate effects of storm surge and inundation in the southeastern United States and Gulf of Mexico. Funding for enhancements to the GCOOS is being sought from governmental and private sources. For GCOOS to evolve to its full potential, new federal resources targeted to regional coastal ocean observing systems must be committed.

Lazo, Jeffrey K., and Walter Gillis Peacock. 2007. Social science research needs for the hurricane forecast and warning system: An introduction. *Natural Hazards Review* 8(3): 43-49.

Lee, Kyung Ho, and David V. Rosowsky. 2007. Synthetic hurricane wind speed records: Development of a database for hazard analyses and risk studies. *Natural Hazards Review* 8(2): 23-34.

A database of synthetic hurricane wind speeds is developed for a region of the southeastern United States comprising South Carolina, North Carolina, and eastern Virginia. For each zip code in the study region, the database includes a time index (year), duration of strong winds, and peak surface wind speeds (both gust and sustained). Synthetic wind speed records for 15,000 years are developed using an event-based simulation approach (a modeling approach in which each hurricane is simulated as a discrete stochastic event) based on the empirical tracking and central pressure models proposed by Vickery et al. in 2002. The Vickery model considers storm formation and movement including time-varying central pressure from anywhere in the Atlantic Ocean including the Gulf of Mexico. An improved decay model is developed based specifically on statistical analysis of historical hurricane central pressure data from the study region. The results are stored in a database that can be easily mined for site and region-specific hurricane hazard analyses as well as short- and long-term risk studies. Surface wind speed time-histories also were developed at each zip code for a number of recent hurricanes including Fran (1996), Bonnie (1998), Dennis (1999), Floyd (1999), Isabel (2003), and Charley (2004). The wind speed database for these historical hurricanes may be useful for developing hurricane damage (loss) models.

Letson, David, Daniel S. Sutter, and Jeffrey K. Lazo. 2007.

Economic value of hurricane forecasts: An overview and research needs. *Natural Hazards Review* 8(3): 78-86.

Hurricane forecasting is in part an economic problem, because it commits scarce resources to save lives, reduce injuries, and lessen economic impacts. New sensing, recording, and reporting technologies, as well as the increased number of clients and their changing needs, have heightened the need to economically justify the hurricane warning system. Estimating forecast value can help show if improved forecast provision and dissemination would offer more benefit to society than alternative public investments such as infrastructure or forecasts of other hazards. We review research that has estimated the economic value of the hurricane forecast and warning system and the value of improving forecast quality. We recommend developing a comprehensive theoretical understanding of economic value of hurricane forecasts to diverse stakeholders across all time scales. This improved, basic understanding would involve a more in-depth discussion of the value of information as well as a broader knowledge of actual (or created) distinctions between adaptation, mitigation, and response to hurricane risks.

Lindell, Michael K., Carla S. Prater, and Walter Gillis Peacock. 2007. Organizational communication and decision making for hurricane engineers. *Natural Hazards Review*, 8(3): 50-60.

This paper reviews research and theory on the processes by which emergency relevant organizations communicate with each other and with the population at risk from hurricanes. The technology for hurricane forecast, warning, and protective action has made significant advances in the past 20 years, but there is a disturbing potential for hurricane

strikes that could cause a large number of casualties in addition to the predictably large economic cost from property destruction. Consequently, social science research is needed to expand the existing knowledge base on the response of households, businesses, and special facilities to hurricane warnings. Available research suggests local officials need better information about evacuation time estimates, evacuation costs, and the potential loss of life in a late evacuation. They also need improved decision support systems that will facilitate the choice of appropriate protective actions when hurricanes threaten their jurisdictions.

raises important considerations, including recommendations for the future. The results of flood-damage surveys conducted in Lakeview and the Lower Ninth Ward districts of New Orleans reveal an intriguing aspect: Unlike in Lakeview, which filled with water over a period of hours, intense and widespread flash flooding occurred east of the Industrial Canal, yielding damage similar to that from an F4/F5 tornado. Perhaps more importantly, the article explores various reasons for why some people from these areas did not or will not evacuate when faced with imminent danger. Analyzing the events leading up to and following Katrina's landfall can help us understand how such senseless tragedy resulted from several fatal flaws: denial, woeful preparation, and poverty. Given that Gulf Coast residents now live within a climate pattern of enhanced hurricane frequency and intensity compared to the three-decade period pre-1995, the best advice for those asked to evacuate is to just say yes. While this piece reads as a more personal account than most on the subject, it is hoped that it offers an intriguing perspective on the cultural issues impacting evacuations.

Malone, Thomas C., and J. Michael Hemsley. 2006-2007.

Developing the IOOS for improved management and mitigation of coastal inundation. *Marine Technology Society Journal* 40(4): 45-55.

Ocean.US was established by the National Ocean Research Leadership Council in 2000 to 1) design and prepare strategic plans for implementing and improving an integrated ocean observing system (IOOS) for the United States, 2) promote coordinated implementation of these plans, and 3) promote research and development needed to improve operational capabilities. Among the highest priorities for phased development of the IOOS is improving capabilities to predict, manage, and mitigate effects of coastal inundation caused by hurricanes, tropical storms, extra-tropical cyclones, nor'easters, and tsunamis. Based on the needs of three categories of users (real-time responders, post-event rebuilders, and long-term planners), high priorities for IOOS development are to 1) improve the accuracy and timeliness of forecast maps of the time-space extent of coastal inundation and 2) periodically provide accurate, high resolution, timely assessments of changes in susceptibility (vulnerability and risk) to and impacts of coastal inundation. Data requirements and advances in operational modeling capabilities to address these objectives and actions needed to achieve them are described. A key action for meeting these requirements is the development of community modeling approaches to enable more effective collaboration among research and operational communities to improve and expand operational modeling capabilities in support of decision making by all three categories of users. Community modeling activities should include coordinated development of observational and modeling capabilities and the development of test beds, ensemble modeling capabilities, and experiments to validate models and improve predictive skills (e.g., Observing System Simulation Experiments).

Monfredo, William. 2007. Living, leaving, and dying for New Orleans: An insider's perspective on Katrina. *Journal of Emergency Management* 5(2): 13-21.

This article discusses Hurricane Katrina's meteorological setting and history, surrounding evacuation issues, and aftermath. The author, who lived in New Orleans for more than three years, taught and researched climatic hazards at the University of New Orleans, and was no stranger to evacuations, began driving to Tucson 18 hours before Katrina's landfall and returned five months later. The article

Osei, Philip D. 2007. Policy responses, institutional networks management and post-Hurricane Ivan reconstruction in Jamaica. *Disaster Prevention and Management* 16(2): 217-34.

This paper seeks to investigate how the Government and people of Jamaica responded to the onslaught of Hurricane Ivan in September 2004, against the background of the established institutional response framework, including the Disaster Preparedness and Emergency Management Act (1993) and Disaster Prevention and Emergency Management Plan of 1983 and established norms of practice. Qualitative methods for primary research were adopted in the study including elite interviews, attendance at press briefings, and reviews of policy documents and media reports. It also adopted a critical application of policy outcomes frameworks in a bid to interpret and evaluate the policy interventions during the event of Ivan. Findings: The research revealed the following: that established configurations of working relations were upset by the establishment of an ad hoc reconstruction agency called Office of National Reconstruction (ONR); that the decentralized institutional level of response, the Parish Disaster Committees, were expected to possess the relevant capacity for assessment and response, even though these committees had not been capacitated to make an appropriate response; that by placing the ONR outside the legally established response agency, the government had weakened the prospects for institutional learning and preservation of institutional memory, as well as generated undue conflict which impinged on coordination, at a time when unity of purpose was most required. This paper posits that if there was a real and continuous need for an ONR, then its location would be better within the Office of Disaster Planning and Emergency Management. It also suggests that the Parish Disaster Committees are critical to disaster prevention and management as they are located at the interface between government and community, and should be appropriately empowered to play their role.

Pietrafesa, L. J., K Kelleher, T. Karl, M. Davidson, M. Peng, S. Bao, D. Dickey, L. Xie, H. Liu, and M. Xia. 2006-2007. A new architecture for coastal inundation and flood warning prediction. *Marine Technology Society Journal* 40(4): 71-77. The marine atmosphere, coastal ocean, estuary, harbor, and river water systems constitute a physically coupled system. While these systems have always been heavily impacted by coastal storms, increases in population density, infrastructure, and personal and business merchandise have exacerbated the economic and personal impacts of these events over the past half century. As such, there has been increased focus on the need for more timely and accurate forecasts of impending events. Traditionally model forecast architectures for coastal storm surge, flooding, and inundation of coastal and inland areas have taken the approach of dealing with each system separately: rivers, estuaries, harbors, and offshore facing areas. However, given advances in coupled modeling and the availability of real-time data, the ability to accurately predict and project coastal, estuary, and inland flooding related to the passage of high energy and wet atmospheric events is rapidly emerging and requires a new paradigm in system architecture. No longer do monthly averaged winds or river discharge or water levels have to be invoked in developing hindcasts for planning purposes or for real-time forecasts. In 1999, a hurricane-associated flood on the North Carolina coast took 56 lives and caused more than \$6 billion in economic impacts. None of the models existing at that time were able to properly forecast the massive flooding and clearly called for a new model paradigm. Here we propose a model system that couples atmospheric information to fully three-dimensional, non-linear, time-dependent ocean basin, coastal, and estuary hydrodynamic models coupled to interactive river models with input of real or modeled winds, observed or modeled precipitation, measured and modeled water levels, and streamflow. The river and estuarine components must both be capable of going into modes of storage or accelerated discharge. Spatial scales must downscale in the horizontal from thousands to tens of meters and in the vertical from hundreds to several centimeters. Topography and elevation data should be of the highest resolution available, necessary for highly accurate predictions of the timing and location of the inundation and retreat of flood waters. Precipitation information must be derived from the optimal mix of direct radar, satellite, and ground-based observations. Creating the capability described above will advance the modernization of hydrologic services provided by the National Oceanic and Atmospheric Administration and provide more accurate and timely forecasts and climatologies of coastal and estuary flooding. The goal of these climatologies and improved forecasts is to provide better information to local and regional planners, emergency managers, and highway patrols, and to improve the capacity of coastal communities to mitigate against the impacts of coastal flooding.

Puszkin-Chevlin, Ana, Debra Hernandez, and James Murley. 2006-2007. Land use planning and its potential to reduce hazard vulnerability: Current practices and future possibilities. *Marine Technology Society Journal* 40(4): 7-15.

The concentration of people and infrastructure along the nation's coastline has increased our vulnerability to severe coastal storms and other natural hazards, as evidenced by the substantial social, economic, and environmental impacts of recent hurricanes. Competing policy objectives and stakeholder interests pose challenges to planners' and public officials' attempts to increase resilience using land development-based approaches. This paper describes these issues for researchers outside the urban and regional planning discipline. It presents the typical approaches to hazard mitigation and the primary land-use tools used to manage coastal development. It strives to inspire interdisciplinary visioning of sustainable coastal development patterns needed to advance resiliency.

Stockdon, Hilary F., W. Jeff Lillycrop, Peter A. Howd, and Jennifer M. Wozencraft. 2006-2007. The need for sustained and integrated high-resolution mapping of dynamic coastal environments. *Marine Technology Society Journal* 40(4): 90-99.

Vermette, Stephen. 2007. Storms of tropical origin: a climatology for New York State, USA (1851-2005) . *Natural Hazards*, 42(1): 91-103.

The tropical storm database used in this study was obtained from the National Oceanic and Atmospheric Administration's (NOAA) Coastal Service Center, using the Historical Hurricane Tracks tool. Queries were used to determine the number of storms of tropical origin that have impacted the state and each of its counties. A total of 76 storms of tropical origin passed over New York State between 1851 and 2005. Of these storms, 14 were classified as hurricanes. The remaining hurricanes passed over New York State as weaker or modified systems—27 tropical storms, 7 tropical depressions, and 28 extratropical storms (ET). Long Island experiences a disproportionate number of hurricanes and tropical storms. The average frequency of hurricanes and storms of tropical origin (all types) is one in every 11 years and one in every 2 years, respectively. September is the month of greatest frequency for storms of tropical origin, although the storms of greatest intensity tend to arrive later in the hurricane season and follow different poleward tracks. While El Niño Southern Oscillation (ENSO) cycles appear to show some influence, the frequency and intensity of storms of tropical origin appear to follow a multidecadal cycle. Storm activity was greatest in both the late 19th and 20th centuries. During periods of increased storm frequency and intensity, storms reached New York State at progressively later dates. While the number and timing of storms of tropical origin is likely to increase, this increase appears to be attributed to a multidecadal cycle, as opposed to a trend in global warming.

Information and Spatial Technology

Friesen, Kenton, and Doug Bell. 2007. Regional health authorities, disaster management, and geomatics: Opportunities and barriers. *International Journal of Emergency Management* 4(2): 141-65.

As society becomes increasingly urbanized, the relationship between the built environment and risk also becomes increasingly complex. Disaster management and public health professionals are employing technology as tools to assist them with understanding these complexities. Specifically, geomatics technology is connecting the power of spatial analysis with the efficiency of database management. Within the public health system, implementing geomatics technology has barriers related to a misconception or misunderstanding of its capabilities. Overcoming the barriers at Regional Health Authorities (RHAs) requires a coordinated effort or strategy. With the absence of these coordinated efforts and strategies, RHAs will struggle with implementing geomatics technology. In order to take full advantage of geomatics technology for mitigation, preparedness, response, and recovery purposes, RHAs will need to evaluate their commitment to the technology and allocate valuable resources appropriately.

provided by authorities for the public via the Internet. Crucial research questions were: How well are these risk communication means used by residents, and why or why not? How likely are they to significantly advance problem awareness, preparedness, and coping with actual fires? How can the usability and effectiveness of these tools for individual emergency management be improved? Last year a study was conducted and participants were experienced students; they assessed internet information of fire authorities in South Australia, Victoria, and New South Wales, focusing on then present bushfire events. Predominantly, these Web sites were found to be informative, comprehensive, and helpful. However, the respondents also identified shortcomings, in both content and presentation of fire preparedness information for residents, and stated limitations of addressing cultural variety. Obviously there is considerable potential for the improvement of Web sites. Pertinent suggestions and resultant research needs to be outlined.

Martin, Nigel. 2007. The Asian tsunami: An urgent case for improved government information systems and management. *Disaster Prevention and Management* 16(2): 188-200.

This paper seeks to provide a timely consideration of how regional governments in Asia and other national governments around the world collect, manage, and share critical geotechnical information in what is becoming an increasingly global community. The paper addresses the socio-technical perspective of government information systems and management, and draws on the collection and analysis of several public reports, media articles, and expert opinions published in the aftermath of the Asian tsunami of December 26, 2004. On the basis of the published material, the paper observes how critical early warning information was handled by government authorities in the hours before the tsunami wave strike, discusses the availability of technological solutions that can provide earthquake and tsunami warning information, and poses that government bureaucracies and human relations form the weakest link in the information chain. The paper concludes with a potential research agenda for government warning information systems and management. The type of early warning information system that might be created to avoid another loss of life, suggested improvements to inter-government information sharing and communications, and the emerging requirement for earthquake and tsunami information dissemination and education in lesser developed countries are also discussed. The research enabled the examination of weaknesses in critical information sharing between governments and members of the international community, and highlights the issue of strong human relationships as a key to preventing the loss of life and better managing disasters.

Rohrmann, Bernd. 2007. Exploring information for residents on websites of fire authorities: Practical experiences. *Australian Journal of Emergency Management* 22(2): 10-15. The project potential of the Internet for enhancing residents' bushfire preparedness from 2004-2006 was carried out to analyze the capability and the utility of information sources

Van De Walle, Bartel, and Murray Turoff. 2007. Emergency response information systems: Emerging trends and technologies. *Communications of the ACM* 50(3): 29-31.

Insurance and Economic Impacts

Okuyama, Yasuhide. 2007. Economic modeling for disaster impact analysis: Past, present, and future. *Economic Systems Research* 19(2): 115-24.

Analyzing economic impacts of disasters has attracted interest from a wide audience in recent years, not only because of the frequent occurrence of large natural disasters worldwide but also because of the spread of terrorism to a global scale. This paper reviews past modeling studies for economic impact analysis of disasters, focusing especially on the input-output model and related modeling frameworks, such as the social accounting matrix and the computable general equilibrium model. The paper also discusses the issues of disaster modeling raised by the literature, and proposes some future directions.

Sawada, Yasuyuki, and Satoshi Shimizutani. 2007. Consumption insurance against natural disasters: Evidence from the Great Hanshin-Awaji (Kobe) earthquake. *Applied Economic Letters* 14(4): 303-306.

The authors investigated whether people were insured against unexpected losses caused by the Great Hanshin-Awaji (Kobe) earthquake in 1995 and found that the full consumption insurance hypothesis was rejected overwhelmingly, suggesting the ineffectiveness of the formal/informal insurance mechanisms against the earthquake.

Steenge, Albert E., and Marija Bockarjova. 2007. Thinking about imbalances in post-catastrophe economies: An input-output based proposition. *Economic Systems Research* 19(2): 205-23.

This paper focuses on the consequences of a major catastrophe for a modern economy, where 'major' means

that a significant part of the economy's productive capacity is lost. In the aftermath of the catastrophe, authorities have to address a great number of issues. The authors show, using basic principles, that input-output methodology offers a flexible set of tools to address three fundamental issues: 1) obtaining a systematic insight in the imbalances that exist in the non-affected area after the catastrophe, 2) determining the nature of these imbalances and the way they affect options in the recovery process, and 3) introducing the elements of a cost-benefit analysis in the context of prevention and precautionary policies. The paper's approach strongly supports the need for extensive contingency planning in the presence of major natural hazards. A numerical example accompanies the various steps of the exercise.

(ANN) model that was constructed by seven significant factors using back-propagation (BP) algorithm. These seven factors include: 1) length of creek, 2) average slope, 3) effective watershed area, 4) shape coefficient, 5) median size of soil grain, 6) effective cumulative rainfall, and 7) effective rainfall intensity. A total of 171 potential cases of debris flows collected in eastern Taiwan were fed into the ANN model for training and testing. The average ratio of successful prediction reaching 99.12 percent demonstrates that the presented ANN model with seven significant factors can provide a highly stable and reliable result for the prediction of debris flows in hazard mitigation and guarding systems.

Landslides and Avalanches

Becker, J. S., D. M. Johnston, D. Paton, G. T. Hancox, T. R. Davies, M. J. McSaveney, and V. R. Manville. 2007. Response to landslide dam failure emergencies: Issues resulting from the October 1999 Mount Adams landslide and dam-break flood in the Poerua River, Westland, New Zealand. *Natural Hazards Review* 8(2): 35-42.
On October 6, 1999, a large rock avalanche from Mount Adams on the west coast (Westland) of the South Island, New Zealand, fell into the Poerua Valley. The landslide blocked the river valley, damming the Poerua River and creating a large lake. The potential for overtopping and failure of the landslide dam presented a potential dam-break flood hazard that was assessed as posing a serious danger to Poerua Valley residents located downstream. The dam eventually failed six days after it was formed. Fortunately, the resulting flood was largely confined to the river channel and floodplain areas, causing little damage and no deaths. The Poerua River landslide dam-break flood highlighted a range of issues that should be addressed in managing future landslide dam-break flood emergencies. This paper summarizes the key organizational, community, and response issues arising from a break-out flood such as this. Planning for the management of future landslide dam-break floods may help reduce loss of life from future events. Preparations could include setting aside more resources for assessing the hazard, and improved control and communications for managing the response. From an emergency management perspective, because of the remote and inaccessible location of landslide dam sites in steep mountain valleys on the west coast of New Zealand's South Island, it is important to ensure that the community has direct involvement in the readiness and response process.

Chang, Tung-Chiung. 2007. Risk degree of debris flow applying neural networks. *Natural Hazards* 42(1): 209-24.
A number of methods for prediction of debris flows have been studied. However, the successful prediction ratios of debris flows cannot always maintain a stable and reliable level. The objective of this study is to present a stable and reliable analytical model for risk degree predictions of debris flows. This study proposes an Artificial Neural Networks

Chen, Zhaohua, and Jinfei Wang. 2007. Landslide hazard mapping using logistic regression model in Mackenzie Valley, Canada. *Natural Hazards* 42(1): 75-89.

A logistic regression model is developed within the framework of a Geographic Information System (GIS) to map landslide hazards in a mountainous environment. A case study is conducted in the mountainous southern Mackenzie Valley, Northwest Territories, Canada. To determine the factors influencing landslides, data layers of geology, surface materials, land cover, and topography were analyzed by logistic regression analysis, and the results are used for landslide hazard mapping. In this study, bedrock, surface materials, slope, and difference between surface aspect and dip direction of the sedimentary rock were found to be the most important factors affecting landslide occurrence. The influence on landslides by interactions among geologic and geomorphic conditions is also analyzed and used to develop a logistic regression model for landslide hazard mapping. The comparison of the results from the model including the interaction terms and the model not including the interaction terms indicates that interactions among the variables were found to be significant for predicting future landslide probability and locating high hazard areas. The results from this study demonstrate that the use of a logistic regression model within a GIS framework is useful and suitable for landslide hazard mapping in large mountainous geographic areas such as the southern Mackenzie Valley.

Public Health, Mental Health, and Emergency Medicine

Evans, Linda, and Judy Oehler-Stinnett. 2006. Children and natural disasters: A primer for school psychologists. *School Psychology International* 27(1): 33-55.
Worldwide, children are impacted by natural disasters, including hurricanes, floods, tornadoes, earthquakes, wildfires, landslides and sandstorms, winter and severe storms, heat waves, volcanoes, and tsunamis. School psychologists should understand natural disaster effects, such as economic loss, relocation, health concerns, and mental health issues. While most children are able to cope, a significant minority develops severe symptoms and post-traumatic stress disorder (PTSD). School psychologists should gain trauma mental health training through the

American Psychological Association, the National Association of School Psychologists, and the International School Psychology Association. They can also be involved in school and community prevention, mitigation, and educational programming. This article presents an overview for school psychologists of the literature on children in natural disasters.

Irvin, Charlene B., and Jenny G. Atas. 2007. Management of evacuee surge from a disaster area: Solutions to avoid non-emergent, emergency department visits. *Prehospital and Disaster Medicine* 22(3): 220-223.

Many emergency departments (EDs) in the United States experience daily overcrowding, and a rapid influx of evacuees fleeing a disaster area can pose a substantial burden. Some of these evacuees may require ED care. However, others lack an alternative to the ED to address non-emergent medical concerns. The objective of this study was to describe a successful multidisciplinary Hurricane Katrina Evacuation Center, explain the services offered, and determine the center's effects on referrals to local EDs. Data were collected concerning the number of patients utilizing the medical evaluation center and compared the total number of evacuees to determine the proportion that utilized medical care. The data concerning patients given prescriptions were obtained by the estimation of the two medical directors of the center, and therefore, is inexact. During the five weeks the center was operational, 631 of 716 evacuees requested medical evaluation, and more than 80 percent of those had prescriptions written. Only four patients were transported to local EDs. An evacuee evaluation center provides a convenient non-ED alternative for evacuees to address their non-emergent medical concerns and can be used to ease their transition to a new location.

Jenner, Meredith. 2007. The psychological impact of responding to agricultural emergencies. *Australian Journal of Emergency Management* 22(2): 25-31.

It has increasingly been recognized that emergency responders may suffer stress and adverse psychological reactions to their exposure to traumatic events and the nature of the work they are expected to perform. However, little previous research has focused on the psychological impact of responding to agricultural emergencies. While these types of emergencies have some stressors in common with 'traditional' emergencies, there are a number of factors that are more specific to agricultural emergencies. These are explored in the context of the existing literature and interventions or preventative measures suggested to mitigate the possible negative impact of responding to agricultural emergencies.

Maguire, Brian J., Stephen Dean, Richard A. Bissell, Bruce J. Walz, and Andrew K. Bumbak. 2007. Epidemic and bioterrorism preparation among emergency medical services systems. *Prehospital and Disaster Medicine* 22(3): 236-42.

The purpose of this research was to determine the preparedness of emergency medical services (EMS) agencies

in one U.S. state to cope with a massive epidemic event. Data were collected primarily through telephone interviews with EMS officials throughout the state. To provide a comparison, nine out-of-state emergency services agencies were invited to participate. Emergency medical services agencies from nine of the 23 counties provided responses to some or all of the questions in the telephone survey. Seven of the nine out-of-state agencies provided responses to the survey. Most of the EMS agencies do not have broad, formal plans for response to large-scale bioterrorist or pandemic events. The findings indicate that EMS agencies in this state fundamentally are unprepared for large-scale bioterrorism or pandemic event. The few existing plans rely heavily on mutual aid from agencies that may be incapable of providing such aid. Therefore, EMS agencies must be prepared to manage a response to these incidents without assistance from any agencies outside of their local community. In order to accomplish this, they must begin planning and develop close working relationships with public health, healthcare, and elected officials within their local communities.

Salcioglu, Ebru, Metin Basoglu, and Maria Livanou. 2007. Post-traumatic stress disorder and comorbid depression among survivors of the 1999 earthquake in Turkey. *Disasters* 31(2): 115-29.

This study examined the prevalence of post-traumatic stress disorder (PTSD) and comorbid depression some three years after the August 1999 earthquake in Turkey among a sample of 769 survivors relocated to a permanent housing site built for homeless survivors in the epicenter region. Time since trauma was 3.1 years for 81 percent of the participants and 3.9 years for the remainder. Survivors were assessed using the Screening Instrument for Traumatic Stress in Earthquake Survivors, an easily administered self-rating scale with demonstrated validity. The estimated rates of PTSD and comorbid depression were 40 percent and 18 percent, respectively. Linear regression analyses showed that PTSD strongly related to fear during the earthquake, while depression related to loss of family members. These results suggest that catastrophic earthquakes have long-term psychological consequences and highlight the need for a cost-effective mental health care model for earthquake survivors.

Smith, Erin. 2007. Emergency health care workers' willingness to work during major emergencies and disasters.

Australian Journal of Emergency Management 22(2): 21-24. Current national and international emergency preparedness plans require emergency health care workers to play an integral role in responding to, and managing major emergencies and disasters. To understand whether emergency health care workers would be willing to work during these events, this study reviewed the international literature to identify seven studies that had addressed this topic. Research conducted in the United States, Canada, Asia, and Israel all came to the same conclusion: The assumption that all emergency health care workers will be willing to work during a major emergency or disaster is not realistic. The impact of this should be considered in emergency preparedness and planning.

Uscher-Pines, Lori. 2007. "But for the hurricane": Measuring natural disaster mortality over the long term. *Prehospital and Disaster Medicine* 22(2): 149-51.

Risk and Decision Making

Ammarapala, Veeris, and James T. Luxhoj. 2007. A collaborative multi-criteria decision making technique for risk factor prioritization. *Journal of Risk Research* 10(4): 465-85.

Organizations are a collection of individuals, and often a disastrous organizational accident involves contributions from several technical/environmental factors and actors throughout the system over time. This paper illustrates the efficiency of a new collaborative decision making technique that could assist a group of executive decision makers in identifying, analyzing, evaluating, and prioritizing significant organizational system risks. The results from the collaborative technique when applied to real-world risk intensive situations, such as aviation safety risk management, are compared with those obtained by using existing notable techniques. For the case examples shown, the number of expert judgments is reduced by up to 80 percent. Advantages and limitations of the proposed modeling approach for collaborative decision making are discussed.

Evans, Robin, David Brereton, and Jim Joy. 2007. Risk assessment as a tool to explore sustainable development issues: Lessons from the Australian coal industry. *International Journal of Risk Assessment and Management* 7(5): 607-19.

Risk assessment is a familiar tool in the minerals industry. Originally introduced to explore areas of safety and health in the workplace, the tool is now increasingly used by the industry in other areas such as environmental management. As the industry grapples with the concept of sustainable development, risk assessment represents a potentially useful methodology to engage operations with the broader range of issues involved. However, a limitation of the traditional risk mitigation approach is that it focuses on avoiding negative outcomes, whereas a sustainability focus requires consideration of positive impacts as well. This paper describes an initial attempt to use modified risk assessment methodologies to engage with three Australian coal mining operations on the subject of sustainable development. It describes the rationale for the project, the outcomes from the trials and the overall lessons from the exercise.

Gruev-Vintila, Andreea, and Michel-Louis Rouquette. 2007. Social thinking about collective risk: How do risk-related practice and personal involvement impact its social representations? *Journal of Risk Research* 10(4): 555-81. The study investigates the effects of personal involvement in a collective risk on the structure of its social representation, and how those effects depend on risk-related experience. The paper reports an empirical study conducted within the structural approach to the Social Representations Theory. The authors tested the effects of risk-related practice (earthquake experience) and of personal involvement in risk

on the structure of its social representation. The results showed that the social representation was normative in nature, but became more practically oriented in the group who experienced earthquake. A normative representation is useful in judging risk's attributes; instead, a more functional, or a more practically oriented representation is expected to enable the use of more diversified risk-related information especially for practical purposes (risk mitigation behavior). Similarly, the social representation of participants who were highly involved in seismic risk was more structured and more practically oriented. However, this was true only if they possessed risk-related experience, either through collective (risk culture) or live earthquake experience. Based on these results, a suggestion is made on how to increase the efficiency of prevention campaigns that aim at encouraging collective risk-mitigation conduct.

Hermansson, Helene, and Sven Ove Hansson. 2007. A three-party model tool for ethical risk analysis. *Risk Management* 9(3): 129-44.

Ethical aspects are crucial in the analysis of risk, but they have often been neglected. One of the reasons for this is the lack of operational tools for the ethical analysis of risks. A model for ethical risk analysis is proposed that focuses on the ethical relationships between three critical parties (or roles) that are present in almost all risk-related decisions: the risk-exposed, the beneficiary, and the decision maker. Seven crucial questions are proposed that can be used to characterize these relationships. It is shown with examples from the railway sector how they can be used to identify the salient ethical features of risk management problems.

Robert, Benoit, Luciano Morabito, and Oliver Quenneville. 2007. The preventive approach to risks related to interdependent infrastructures. *International Journal of Emergency Management* 4(2): 166-82.

Life Support Networks (LSNs) are those entities that provide society with essential resources, such as energy, telecommunications, etc., in order to assure its correct functioning. Thus, the correct functioning of LSNs guarantees the correct functioning of society. However, the growing complexity of LSNs and their interdependencies reveal new vulnerabilities. These interdependencies are a true means of propagation of hazards between networks. The current methods of risk management (often based on probabilistic approaches, analyses of worst case scenarios, and/or aiming at the modeling of the interdependencies) are hardly applicable to the concrete realities of complex and dynamic systems such as LSNs. To compensate for these gaps, the Center has developed, jointly with multiple partners, a new proactive method of risk management based on the prevention and the anticipation of harmful consequences that would affect LSNs. In this paper, the authors present this methodology and its operational tools.

Visschers, Vivianne H. M., Ree M. Meertens, Wim F. Passchier, and Nanne K. De Vries. 2007. An associative approach to risk perception: Measuring the effects of risk communication directly and indirectly. *Journal of Risk Research* 10(3): 371-83.

Risk perception is often measured by a direct method (e.g., a questionnaire). This mainly reveals the deliberate evaluation of a risk (a so-called secondary evaluative process), whereas risk perception can also be based on a first, spontaneous reaction (a primary evaluative process). An indirect test such as the Extrinsic Affective Simon Task (EAST, De Houwer, 2003) may be needed to reveal this first, spontaneous reaction. In this study, a questionnaire and an EAST measured the effects of varying risk communications (high risk, low risk, or control article), about high-voltage power lines. The results of the EAST showed that the respondents associated power lines stronger with unhealthy than with healthy. However, the questionnaire results did not seem to indicate that the respondents considered power lines as risky. The EAST did not reveal an effect of article variation on the associations of power lines with (un)healthy. Conversely, the questionnaire results showed that article variation influenced the secondary evaluative process. Further, the findings demonstrated that the direct and indirect measures were unrelated. An indirect test may complement a direct test to get an overall picture of how people evaluate risks.

Technological Hazards

Abkowitz, Mark, John Allen, Art Greenberg, Mark Lepofsky, and Tom McSweeney. 2007. An evolving paradigm for managing hazardous materials transportation risk. *International Journal of Critical Infrastructures* 3(3/4): 268-86.

The advent of terrorist activity has taught us that managing hazardous materials transportation risk must be performed with a different lens to accommodate terrorism scenarios that may not have previously warranted such formal attention. Given these circumstances, a new paradigm must emerge for managing the risks associated with transport of Hazardous Materials (HM), one that explicitly considers the likelihood and consequences of terrorist attacks, while preserving consideration of risks posed by accidents and natural hazards. This article presents a review of traditional risk assessment methods and practices as applied to the transport of HM, introduces the challenge of assessing security risks, and describes a methodology for constructing a systematic, integrated risk assessment process for addressing natural and human-induced disasters, be they accidental or planned. The methodology is subsequently applied to various classes of HM transported by highway, both to illustrate the methodology as well as to interpret the results. The paper concludes with a discussion of the findings and implications associated with this effort.

Lemak, Rosalyn. 2007. Carbon monoxide poisoning from devices used in disaster recovery. *Journal of Emergency Management* 5(3): 25-32.

Carbon monoxide (CO) is responsible for more fatalities in the United States each year than any other toxicant. While CO exposure is a year-round problem, fatal and nonfatal CO exposures occurred more often during the fall and winter months, and the majority of nonfatal CO exposures were

reported to occur in the home. Post-disaster CO poisoning is an emerging hazard. Unintentional CO poisonings have been documented after natural disasters like hurricanes, floods, ice storms, and power outages. Overwhelmingly, CO exposure results from common sources such as portable generators, gas grills, kerosene and propane heaters, pressure washers, and charcoal briquettes. Although disaster events are thought to create victims immediately and in great numbers during the initial impact, some disasters are more deadly to people during the recovery phase, when people are thinking the disaster is over. More are injured during the cleanup phase than from the storm itself.

Shaluf, Ibrahim Mohamed. 2007. An overview on the technological disasters. *Disaster Prevention and Management*, 16(3): 380-390.

The purpose of this paper is to provide graduate students, researchers, and governmental and independent agencies with an overview of technological disasters. Technological disasters are subjects of concern to researchers, academicians, and governmental and independent agencies. Disasters are classified into natural and human-induced disasters. For an incident to be classified as a disaster, the disaster criteria should be met. Several disaster criteria have been proposed defining the disasters in terms of casualties, economic loss, and environmental impact. The disasters that involve major hazard installations (MHIs) are known as technological disasters. The technological disaster definition, stages, types, criteria, factors, and models have been reviewed. This paper presents an overview of technological disaster definition, criteria, stages, models, factors, and prevention. Although the technological disasters may occur at non-MHIs, it has been noted that most of the technological disasters involved MHIs and that their impact are not limited to the plants but can extend to neighboring surroundings. The technological disaster consists of three stages: before, during, and after disaster. There are many factors contributing to the technological disasters, some of which are observed clearly, while others are partially hidden. The main technological disaster factors were identified as human, organizational, and technological errors. Few models have been drawn describing the sequence of development of the technological disaster. This paper presents an overview on the technological disaster definition, criteria, types, stages, models, factors, and prevention, and combines the scattered information on technological disaster into one record.

Suris-Regueiro, Juan C., M. Dolores Garza-Gil, and Manuel M. Varela-Lafuente. 2007. The *Prestige* oil spill and its economic impact on the Galician fishing sector. *Disasters* 31(2): 201-15.

The sinking of the *Prestige* oil tanker on November 18, 2002, off the coast of Galicia, Spain, had important economic, environmental and social ramifications. The aim of this paper is to carry out an initial analysis of the costs related to a halt in fishing activities in Galicia between November 2002 and December 2003. This involves three different steps: an assessment of the cost of the preventative and palliative measures introduced by Spanish public administrations

(compensation for affected fishermen and shellfish fisherman); an indirect evaluation of the implications of the disaster (via a study of data on production); and a direct appraisal of the economic impact of the event (reduction in income), using questionnaires completed by a representative sample of fishermen and shellfish fisherman. The results obtained from these three methods of estimating losses are compatible. By December 2003, losses to the Galician fishing sector stood at an estimated EUR 76 million.

Tsunamis

Dominey-Howes, Dale, Phil Cummins, and David Burbidge.

2007. Historic records of teletsunami in the Indian Ocean and insights from numerical modeling. *Natural Hazards*, 42(1): 1-17.

Following the catastrophic "Great Sumatra-Andaman" earthquake-tsunami in the Indian Ocean on the December 26, 2004, questions have been asked about the frequency and magnitude of tsunami within the region. This article presents a summary of the previously published lists of Indian Ocean tsunami (IOT) and the results of a preliminary search of archival materials held at the India Records Office at the British Library in London. The authors demonstrate that in some cases, normal tidal movements and floods associated with tropical cyclones have been erroneously listed as tsunami. They summarize archival material for tsunami that occurred in 1945, 1941, 1881, 1819, 1762, and a little known tsunami in 1843. We present the results of modeling of the 2004, 1861, and 1833 tsunami generated by earthquakes off Sumatra and the 1945 Makran earthquake and tsunami, and examine how these results help to explain some of the historical observations. The highly directional component to tsunami propagation illustrated by the numerical models may explain why we are unable to locate archival records of the 1861 and 1833 tsunami at important locations like Rangoon, Kolkata (formally Calcutta), and Chennai (formally Madras), despite reports that these events created large tsunami that inundated western Sumatra. The numerical models identify other areas (particularly the central and southern Indian Ocean islands) where the 1833 tsunami may have had a large enough effect to produce a historic record. The authors recommend further archival research, coastal geological investigations of tsunami impacts, and detailed modeling of tsunami propagation to better understand the record and effects of tsunami in the Indian Ocean and to estimate their likelihood of occurring in the future.

Hyndman, Jennifer. 2007. The securitization of fear in post-tsunami Sri Lanka. *Annals of The Association of American Geographers* 97(2): 361-72.

Fear is a potent political resource that is at once an expression of vulnerability to geopolitical threats and a rationale for security measures against them. It is produced through tropes of nationalism rooted in economic marginalization, loss of territory, and anxieties about invasions of home. Such anxieties give rise to the securitization of fear used to underwrite the allocation of

resources to fortify borders and manage risk. The securitization of fear and its geopolitical uses and abuses in the context of disaster, conflict, and human displacement demand further attention. This article examines two expressions of fear that have significant implications for broader research agendas in political geography. First, in post-tsunami Sri Lanka, the implementation of "buffer zones," or no-build setback areas along the affected coastlines after the tsunami, vividly illustrates how efforts to enhance public safety can stir feelings of discrimination, tension, and fear. Humanitarian remedies that are not cautiously conflict-sensitive can unwittingly generate fear and mistrust. Second, the politics of fear intersect with the provision of international aid, which is increasingly premised on vulnerability "at home" in donor countries to make it politically relevant. Once created, such crises are offset by aid to locations that represent geopolitical threats. Unraveling the ways in which fear is produced and framed to justify violence, exclusion, and hatred is a pressing political and intellectual task within geography.

Rossetto, T., N. Peiris, A. Pomonis, S. M. Wilkinson, D. Del Re, R. Koo, and S. Gallocher. 2007. The Indian Ocean tsunami of December 26, 2004: Observations in Sri Lanka and Thailand. *Natural Hazards* 42(1): 105-24.

On December 26, 2004, a great earthquake occurred off the western coast of Sumatra triggering a series of tsunami waves that propagated across the Indian Ocean causing damage and life loss in 12 countries. This paper summarizes the observations of lifeline performance, building damage and its distribution, and the social and economic impact of the tsunami made by the Earthquake Engineering Field Investigation Team (EEFIT) in Thailand and Sri Lanka. EEFIT operates under the umbrella of the UK's Institution of Structural Engineers. It is observed that good engineering practice can reduce economic losses, but additional measures are required to reduce risk to life.

Warnings and Evacuations

Dash, Nicole, and Hugh Gladwin. 2007. Evacuation decision making and behavioral responses: Individual and household. *Natural Hazards Review* 8(3): 69-77.

Researchers have examined a wide range of factors that affect evacuation decisions after people hear hurricane forecasts and other information. This review of the literature focuses on three broad areas of research that often overlap: warning, risk perception, and evacuation research. Whereas it is challenging to demarcate the literature along these lines, the authors believe each of these areas represents important dimensions of evacuation decision making. The literature on warning focuses to varying degrees on warning as a social process, rather than a simple result of hearing official warnings. Warnings by themselves do not motivate evacuation; people must perceive risk. The extensive literature on objective and subjective processes in risk perception has to be evaluated. The review concludes with a focus on some important work in modeling evacuation and evacuation decision making. Finally, the authors present recommendations for future research that draws on the

strength of earlier work while focusing more directly on risk, the information included in hurricane forecasts, and the timing of those forecasts.

Gershon, Robyn R. M., Kristine A. Qureshi, Marcie S. Rubin, and Victoria H. Raveis. 2007. Factors associated with high-rise evacuation: Qualitative results from the World Trade Center evacuation study. *Prehospital and Disaster Medicine* 22(3): 165-73.

Due to the fact that most high-rise structures are constructed with extensive and redundant fire safety features, current fire safety procedures typically only involve limited evacuation during minor to moderate fire emergencies. Therefore, full-scale evacuation of high-rise buildings is highly unusual and consequently, little is known about how readily and rapidly high-rise structures can be evacuated fully. Factors that either facilitate or inhibit the evacuation process remain under-studied. This paper presents results from the qualitative phase of the World Trade Center Evacuation Study, a three-year, five-phase study designed to improve the understanding of the individual, organizational, and environmental factors that helped or hindered evacuation from the World Trade Center Towers 1 and 2, on September 11, 2001. On the individual level, factors that affected evacuation included perception of risk, preparedness training, degree of familiarity with the building, physical condition, health status, and footwear. Individual behavior also was affected by group behavior and leadership. At the organizational level, evacuation was affected by offsite preparedness planning, including training and education of building occupants, and risk communication. The environmental conditions affecting evacuation included smoke, flames, debris, general condition of degree of crowdedness on staircases, and communication infrastructure systems. Various factors at the individual, organizational, and environmental levels were identified that affected evacuation. Interventions that address the barriers to evacuation may improve the full-scale evacuation of other high-rise buildings under extreme conditions. Further studies should focus on the development and evaluation of targeted interventions, including model emergency preparedness planning for high-rise occupancies.

Hall, Philip. 2007. Early warning systems: Reframing the discussion. *Australian Journal of Emergency Management* 22(2): 32-36.

In recent years, the focus of the international community in relation to risk, disaster, or emergency management has shifted from the development of disaster response capabilities to the need to strengthen risk reduction and control mechanisms and policies, with a particular interest in the design and implementation of better early warning systems as a major mitigator of disasters. The emphasis on early warning systems has turned attention and funding to the current capabilities and developments in science and technology, and unfortunately, distracted us from the central issue of addressing the real needs of the communities and people at risk. This paper argues from a background in mission critical systems, project management, and business performance, that we cannot achieve the risk reduction and

mitigation we seek until the emphasis is placed on the leadership role of emergency management in providing an effective early warning capability through the integration of the improvements in science and technology with traditional methods and an expanded commitment and involvement by all those at risk.

Johnston, David, Julia Becker, Chris Gregg, Bruce Houghton, Douglas Paton, Graham Leonard, and Ruth Garside. 2007. Developing warning and disaster response capacity in the tourism sector in coastal Washington, USA. *Disaster Prevention and Management* 16(2): 210-216.

There has been a considerable effort over the last decade to increase awareness of the tsunami risk in coastal Washington, USA. However, contemporary research on warning systems spawned by the recent Indian Ocean tsunami tragedy highlights the need for development of an effective tsunami warning system for both residents and transient populations, including visitors and tourists. This study sets out evaluate staff training for emergencies, emergency management exercises (including drills and evacuation), and hazard signage within motels and hotels in Ocean Shores, Washington, USA. Data were collected from interviews with reception staff and managers at 18 hotels, motels, and other accommodation establishments. Levels of staff training and preparedness for tsunami and other hazards were found to be generally very low, although examples of "best practice" were found at a select few establishments. Larger hotels already had orientation or general training programs set up that had the potential to incorporate future tsunami and hazard training, while smaller "owner-operator" businesses did not. Suggestions on how to improve preparedness are discussed, including undertaking training needs analyses and conducting workshops, simulations, and employee training to empower both businesses and employees. This case study provides an insight into the challenges faced by emergency managers and the tourism sector in improving the effectiveness of warning systems in areas with high transient populations.

Manning, Michael A. 2007. The effectiveness of NOAA weather radio as an all-hazards alert method in Eastern Loudoun County, Virginia. *Journal of Emergency Management* 5(3): 39-48.

This article examines the results of a study to determine the effectiveness of National Oceanic and Atmospheric Administration (NOAA) Weather Radios as a method of all-hazards public alert in Eastern Loudoun County, Virginia, and identifies the primary obstacles to be overcome to improve system effectiveness.

Still, G. Keith. 2007. Review of pedestrian and evacuation simulations. *International Journal of Critical Infrastructures* 3(3/4): 376-88.

Simulating emergency evacuations has grown in popularity since the tragic events of 9/11. Unfortunately there are a large number of modeling, simulation, animation, and computer graphics systems available today— many of which are misleading. Models and simulations fall into two main categories: microscopic and macroscopic. The authors

highlight the general differences in these approaches, outlining the strengths and weaknesses in both approaches. They examine the fundamental principles of pedestrian and evacuation simulations in this paper and guide the reader towards a greater understanding of crowd dynamics and evacuation analysis. A background to modeling and simulations, their purpose and objectives, followed by a risk assessment analysis description, is presented. The authors further highlight the different type of evacuation scenarios that need consideration when choosing a modeling/simulation tool and conclude with a checklist for choosing an evacuation analysis system.

Wildfires

Bushnell, Sally, and Alison Cottrell. 2007. Increasing community resilience to bushfire: Implications from a north Queensland community case study. *Australian Journal of Emergency Management* 22(2): 3-9.

Increasing community resilience to the bushfire hazard through raising awareness and increasing preparedness for bushfire is a crucial step towards reducing the impact of a bushfire event. The case study presented in this paper investigates the attitudes, expectations, and needs of a community in north Queensland in regard to the bushfire risk in their area. Understanding these social aspects, and community itself, can lead to better delivery of bushfire services, and thereby increase community resiliency. The findings from the case study present a number of implications for bushfire service delivery in the area.

Cox, Robin S. 2007. Capacity building approaches to emergency management in rural communities: Recommendations from survivors of the British Columbia Wildfires, 2003. *International Journal of Emergency Management* 4(2): 250-268.

This paper responds to the ongoing calls within emergency management for more community-driven and capacity building approaches to the response to and recovery from natural disasters. Moving from the rhetoric of community-driven approaches to the practice, this paper highlights and draws on specific practice recommendations made by residents in two rural Canadian communities affected by a devastating forest fire. The recommendations made by the survivors of the McLure Fire, in British Columbia, Canada, provide a concrete framework for engaging with rural communities in developing emergency management practices that are more relevant to and congruent with the unique challenges and strengths of their communities.

Donovan, Geoffrey H., Patricia A. Champ, and David T. Butry. 2007. Measuring the efficacy of a wildfire education program in Colorado Springs. *Journal of Emergency Management* 5(3): 33-37.

Drought conditions in much of the West, increased residential development, and elevated fuels from a century of wildfire suppression have increased wildfire risk in the United States. In light of this increased risk, an innovative wildfire risk education program in Colorado Springs was examined, which rated the wildfire risk of 35,000 homes in

the city's wildland-urban interface. Evidence from home sales before and after the program's implementation suggests that the program was successful at changing homebuyer's attitudes toward wildfire risk, particularly preferences for flammable building materials.

Hammer, Roger B., Volker C. Radeloff, Jeremy S. Fried, and Susan I. Stewart. 2007. Wildlandurban interface housing growth during the 1990s in California, Oregon, and Washington. *International Journal of Wildland Fire* 16(3): 255-65.

In this study, the authors examine housing growth in California, Oregon, and Washington in the wildland/urban interface (WUI), the area where homes and other structures abut or intermingle with wildland vegetation. They combine housing density information from the 1990 and 2000 U.S. censuses with land cover information from the 1992/93 National Land Cover Dataset to demarcate the location and extent of the WUI and its growth, both in terms of area and number of housing units during the 1990s. They overlay the WUI with coarse-scale fire regime condition class information to evaluate implications for wildland fire management. During the 1990s, WUI area in the three-state region increased by 5,218 square kilometers (10.9 percent) to nearly 53,000 square kilometers, and the number of housing units in the WUI increased over 1 million units (17.6 percent) and in 2000 encompassed 6.9 million units, 43 percent of all housing in the region. Over a million new homes were constructed in the WUI, comprising 61 percent of the new homes constructed in the region. By 2000, there was far more intermix WUI (75 percent of the WUI area and 64 percent of the WUI housing units) than interface WUI. Expansion of the WUI accounted for only 13 percent of WUI housing unit growth and WUI that existed in 1990 encompassed 98 percent of WUI housing units in 2000. In 2000, there were nearly 1.5 million WUI housing units in areas with 035-year fire return intervals and 3.4 million in areas with 35,100+ year fire return intervals. In both these fire regimes, the majority of WUI housing units (66 percent and 90 percent respectively) are in areas with a current condition outside the historic range of variability. Housing growth patterns in this three-state region are exacerbating wildland fire problems in the WUI. Any long-term solution to wildland fire issues in the western United States will have to address housing growth patterns. Using a consistent, nationally applicable assessment protocol, the present study reveals the vast extent of WUI in the west coast states and its growth in the 1990s, and provides a foundation for consistent monitoring efforts.

McMurry, Erin R., Michael C. Stambaugh, Richard P. Guyette, and Daniel C. Dey. 2007. Fire scars reveal source of New England's 1780 Dark Day. *International Journal of Wildland Fire* 16(3): 166-270.

Historical evidence suggests that great wildfires burning in the Lake States and Canada can affect atmospheric conditions several hundred miles away (Smith 1950, Wexler 1950). Several 'dark' or 'yellow' days, as such events are commonly called, have been recorded, often with anecdotal or direct evidence pointing to wildfires as the source

(Plummer 1912, Ludlum 1972). One such 'dark day' occurred across New England in 1780, a year in which people were technologically unable to confirm the source of such a phenomenon. Here we combine written accounts and fire scar evidence to document wildfire as the likely source of the infamous Dark Day of 1780.

Podur, Justin J., and David L. Martell. 2007. A simulation model of the growth and suppression of large forest fires in Ontario. *International Journal of Wildland Fire* 16(3): 285-94.

Most of the area burned by forest fires in Canada is due to the few fires that escape initial attack and become large. The authors of this article have developed a discrete event simulation model of the growth and suppression of large fires in the province of Ontario. Based on fire, weather and suppression data from the Ontario Ministry of Natural Resources, the model includes a logistic regression component to predict the probability that a fire will escape initial attack and burn more than 100 hectares, a component that simulates the growth of large fires based on weather and forest vegetation, and a component that simulates fire suppression by firefighters and aircraft. The authors used their model to predict area burned under mild and severe weather with varying levels of fire suppression resources and found that although severe weather limits fire suppression effectiveness, suppression has a significant effect on area burned even during severe fire seasons.

Pradhan, Biswajeet, Mohd Dini Hairi, and Mohamad Arshad Bin Awang. 2007. Forest fire susceptibility and risk mapping using remote sensing and geographical information systems (GIS). *Disaster Prevention and Management* 16(3): 344-52.

In a tropical country like Malaysia, forest fire is a very common natural and human-induced disaster that prevails in the whole Southeast Asian region throughout the year. Recently, the haze problem in Malaysia has created a lot of awareness among the government and eco-tourism sectors. Therefore, detection of the hotspot is very important to delineate the forest fire susceptibility mapping. In this study, remote sensing and geographical information systems (GIS) have been used to evaluate forest fire susceptibility at Sungai Karang and Raja Muda Musa Forest Reserve, Selangor, Malaysia. Frequency ratio model has been applied for the delineation of forest fire mapping for the study area. Forest fire locations were identified in the study area from historical hotspots data from 2000 to 2005 using AVHRR NOAA 12 and NOAA 16 satellite images. Various other supported data, such as soil maps, topographic data, and agro climate, were collected and created using GIS. These data were constructed into a spatial database using GIS. The factors that influence fire occurrence, such as fuel type and Normalized Differential Vegetation Index (NDVI), were extracted from classified Landsat-7 ETM imagery. Slope and aspect of topography were calculated from a topographic database. Soil type was extracted from a soil database and dry month code from agro-climate data. Forest fire susceptibility was analyzed using the forest fire occurrence factors by likelihood ratio method. A new statistical method

has been applied for the forest fire susceptibility mapping. The results of the analysis were verified using forest fire location data with the help of a newly written programming code. The validation results show satisfactory agreement between the susceptibility map and the existing data on forest fire location. The GIS was used to analyze the vast amount efficiently, and statistical programs were used to maintain the specificity and accuracy. The result can be used for early warning and fire suppression resources planning and allocation. All data used in this study are original. The forest fire susceptibility mapping has been done in this study area for the first time. A new program has been coded to cross-verify the susceptibility map. The results were also verified with field data and other supporting weather data.

Pyne, Stephen J. 2007. Problems, paradoxes, paradigms: triangulating fire research. *International Journal of Wildland Fire* 16(3): 271-76.

Wildland fire research has historically orbited around a physical paradigm of fire. This strategy has yielded remarkable results, yet increasingly it cannot speak to the core issues that concern fire management. Two additional paradigms are needed. One would build on fire's origins in the living world. The other would evolve out of fire's significance to humanity, and humanity's unblinking importance to fire's presence on Earth. Note that each paradigm is coherent in itself, that each is capable of absorbing the others, and that each is insufficient on its own. It is unlikely that a master synthesis of these conceptions will emerge, and is not necessary. The need is to sustain research that addresses how fire really exists, not how select sciences can handle it. This essay sketches what the resulting fire-research triangle might look like.

Sadler, Paul, Alina Holgate, and David Clancy. 2007. Is a contained fire less risky than a going fire? Career and volunteer firefighters' perception of risk. *Australian Journal of Emergency Management* 22(2): 44-48.

Since fighting fires can pose a great risk to the lives of firefighters, it is important to understand how they perceive risks in dynamic wildfire situations. The aim of the current study was to determine whether career and volunteer firefighters differ in their perception of the risk of a going vs. contained fire, and whether descriptions of a fire as either going or contained affected perceptions of risk. It was expected that career firefighters would rate a contained fire as significantly riskier than would volunteer firefighters. The sample consisted of 55 career and 84 volunteer CFA Victorian firefighters (134 males and 5 females). An ambiguous wildfire scenario was presented and described as either going or contained, and risk ratings were recorded. Two-way ANOVA results showed that career firefighters rated a going fire as equally risky as a contained fire. On the other hand, volunteer firefighters perceived a fire described to be significantly less risky than a fire described as going, despite the fact that the same foreground conditioned were described in both cases. It was concluded that a framing effect had occurred and that career firefighters demonstrated a higher level of situation awareness than volunteer firefighters due to their heightened levels of risk perception

when exposed to contained wildfire scenarios. A practical implication of the current research is that those conducting firefighting briefings need to be aware of possible framing effects in the way information is presented to firefighters and need to ensure that all briefings make risk cognitively salient to firefighters.

Wind Storms, Winter Storms, and Other Severe Weather

Chang, Stephanie E., Timothy L. McDaniels, Joey Mikawoz, and Krista Peterson. 2007. Infrastructure failure interdependencies in extreme events: Power outage consequences in the 1998 Ice Storm. *Natural Hazards* 41(2): 337-58.

This paper addresses the problem of interdependent failures of critical infrastructures in disasters. Disruptions to critical infrastructure systems, such as electric power or transportation, frequently cause major social and economic loss in disasters, both directly and through failures in one system leading to or compounding disruptions in another. Strategic approaches regarding infrastructure failures are needed to guide community mitigation and preparedness efforts. This paper defines and provides a conceptual framework for investigating infrastructure failure interdependencies (IFIs) from the standpoint of societal impacts. In order to identify empirical patterns, a unique database has been developed of IFIs observed in major electric power outage events. This paper presents analysis of this data for a major Canadian disaster, the 1998 Ice Storm that affected the northeastern region of the country. The analysis identifies IFIs due to power outage caused by the storm that are of greatest societal concern. These represent potential foci for effective, targeted pre-disaster mitigation and preparedness efforts. The framework and approach are broadly applicable across a range of natural and human-induced hazards.

Hui, David Tai-Hui, Karen Kit-Ying Shum, Ji Chen, Shyh-Chen Chen, Jack Ritchie, and John O. Roads. 2007. Case studies of seasonal rainfall forecasts for Hong Kong and its vicinity using a regional climate model. *Natural Hazards* 42(1): 169-91.

Seasonal climate forecasts are one of the most promising tools for providing early warnings for natural hazards such as floods and droughts. Using two case studies, this paper documents the skill of a regional climate model in the seasonal forecasting of below normal rainfall in southern China during the rainy seasons of July–September 2003 and April–June 2004. The regional model is based on the Regional Spectral Model of the National Centers for Environmental Prediction of the United States. It is the first time that the model has been applied to a region dominated by the East Asian Monsoon. The article shows that the regional climate model, when being forced by reasonably good forecasts from a global model, can generate useful seasonal rainfall forecasts for the region, where it is dominated by the East Asia monsoon. The spatial details of the dry conditions obtained from the regional climate model

forecast are also found to be comparable with the observed distribution.

Kitoh, Akio. 2007. Variability of Indian monsoon-ENSO relationship in a 1000-year MRI-CGCM2.2 simulation. *Natural Hazards* 42(2): 261-72.

There is a close relationship between interannual variability of the Indian summer monsoon rainfall and the El Niño/Southern Oscillation (ENSO). However, recent observations suggest a weakening of this ENSO-monsoon relationship that may be linked to global warming. It is reported an analysis of the ENSO-monsoon relationship within the framework of a 1,000-year control simulation of the MRI-coupled general circulation model, MRI-CGCM2.2. This modulation in the ENSO-monsoon relationship is associated with decadal variability of the climate system.

Mohapatra, M., and U. C. Mohanty. 2007. Inter-annual variability of summer monsoon rainfall over Orissa (India) in relation to cyclonic disturbances. *Natural Hazards* 42(2): 301-15.

The summer monsoon rainfall over Orissa, a state on the eastern coast of India, is more significantly related than Indian summer monsoon rainfall (ISMR) to the cyclonic disturbances developing over the Bay of Bengal. Orissa often experiences floods and droughts due to variation in the characteristics of these disturbances. Hence, an attempt was made to find out the inter-annual variability in the rainfall over Orissa during monsoon season. For this purpose, different statistical characteristics, such as mean, coefficient of variation, trends and periodicities in the rainfall, and the frequencies of different categories of cyclonic disturbances affecting Orissa, were analyzed from 100 years of data. The basic objective of the study was to find out the contribution of inter-annual variability in the frequency of cyclonic disturbances to the inter-annual variability of monsoon rainfall over Orissa. The relationship between summer monsoon rainfall over Orissa and the frequency of cyclonic disturbances affecting Orissa shows temporal variation. The correlation between them has significantly decreased since the 1950s. The variation in their relationship is mainly due to the variation in the frequency of cyclonic disturbances affecting Orissa. The variability of both rainfall and total cyclonic disturbances has been above normal since the 1960s, leading to more floods and droughts over Orissa during recent years. There is lesser impact of El Niño southern oscillation (ENSO) on the inter-annual variability of both the seasonal rainfall over Orissa and the frequencies of monsoon depression/total cyclones disturbances affecting Orissa.

Niyogi, Dev, Hsin-I Chang, Fei Chen, Lianhong Gu, Anil Kumar, Surabi Menon, and Roger A. Pielke. 2007. Potential impacts of aerosol-land-atmosphere interactions on the Indian monsoonal rainfall characteristics. *Natural Hazards* 42(2): 345-59.

Aerosols can affect the cloud-radiation feedback and the precipitation over the Indian monsoon region. This paper proposes that another pathway by which aerosols can modulate the multi-scale aspect of Indian monsoons is by altering the land-atmosphere interactions. The nonlinear

feedbacks due to aerosol/diffuse radiation on coupled interactions over the Indian monsoon region are studied by: 1) reviewing recent field measurements and modeling studies, 2) analyzing the MODIS and AERONET aerosol optical depth datasets, and 3) diagnosing the results from sensitivity experiments using a mesoscale modeling system. The results of this study suggest that the large magnitude of aerosol loading and its impact on land-atmosphere interactions can significantly influence the mesoscale monsoonal characteristics in the Indo-Ganges Basin.

Raju, P. V. S, U. C. Mohanty, and R. Bhatla. 2007. Interannual variability of onset of the summer monsoon over India and its prediction. *Natural Hazards* 42(2): 287-300.

In this article, the interannual variability of certain dynamic and thermodynamic characteristics of various sectors in the Asian summer monsoon domain was examined during the onset phase over the south Indian peninsula. Daily average reanalysis data sets of the National Centre for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) for the period 1948-1999 were used. Based on 52 years of onset data of the Indian summer monsoon, the pre-set, onset, and post-set periods were categorized to investigate the interannual variability of significant budget terms over the Arabian Sea, Bay of Bengal, and the Indian peninsula.

Yazdani, Nur, Perry Green, and Saif Haroon. 2007. Wind-missile impact capacity of essential facilities. *Journal of Emergency Management* 5(2): 27-40.

Windborne debris during a hurricane may cause damage to building façades, resulting in significant economic losses and injury or death. Recent building codes have adopted variations of the large-wind-missile impact test in order to certify roof/wall components for hurricane resistance. The purpose of this study was to investigate the performance of commonly used Florida wall and roof assemblies under enhanced large-wind-missile impact testing, beyond the basic test specified in the Florida Building Code. Relevant standards specify similar enhanced standards for essential facilities and shelters. Based on a thorough literature review, a list of wall and roof assemblies that had not been tested before was selected. Wall assemblies included wood and metal framing systems and concrete panels. Roof assemblies included metal framing systems and concrete panels. A comprehensive list of wall and roof assemblies that passed the enhanced test was developed. Assemblies that should be avoided in the construction of essential facilities were also noted.